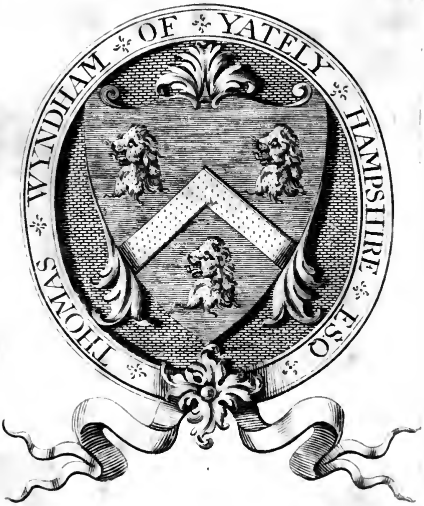
THOMAS WYNDHAM OF YATELY HAMPSHIRE ESQ

SET

2 vol

THE
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OR,
ARCHITECT'S Companion.

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In all the ſeveral

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But alſo containing the

THEORY and PRACTICE

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VOL. II.

LONDON:

Printed for A. BETTESWORTH and C. HITCH, at the *Red-Lion* in *Pater-noſter-Row*; and S. AUSTEN, at the *Angel* and *Bible* in *St. Paul's Church-Yard.*

M.DCC.XXXIV.

THE NEW
BUILDER'S *Dictionary*:
OR,
Gentleman's *and* Architect's
COMPANION.

JAMBS } [in *Carpentry*]
JAUMS } Door-Posts, also the upright Posts at the Ends of Window Frames.

JAMBS } [with *Bricklayers*
JAUMS } &c.] the upright Sides of Chimneys, from the Hearth to the Mantle-Tree.

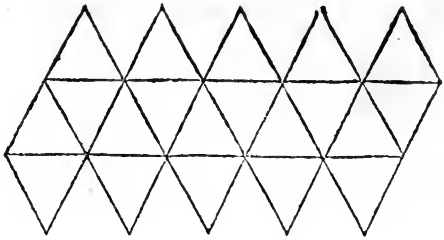
The Word is *Jambe* in *French* and signifies a Leg.

ICHNOGRAPHY [in *Architecture*] a Description or Draught of the Plat-Form or Ground-Work of a House or other Building. Or it is the Geometrical Place or Plat-Form of an Edifice or the Ground-Plot of an House or Building delineated upon Paper, describing the Form of the several Apartments, Rooms, Windows, Chimneys, &c. And this is properly the Business of the Master Architect or Surveyor, being indeed the most abstruse and difficult of any.

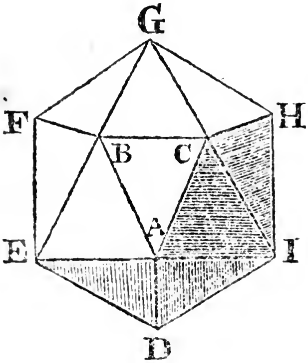
ICHNOGRAPHY [in *Perspective*] is the View of any Thing cut off, by a Plane parallel to the Horizon, just at the Base or Bottom of it.

ICOSIHEDRON is a Solid Body contain'd under 20 equal and equilateral Triangles. Or,

ICOSIHEDRON is a Solid, which consists of 20 triangular Pyramids, whose Vertices meet in the Centre of a Sphere, which is imagined to circumscribe it; and therefore have their Height and Bases equal. Wherefore the Solidity of one of these Pyramids being multiplyed by 20, the Number of Bases, gives the solid Content of the Icosihedron.



This Figure being drawn in Paſt-Board, cut half through and then folded up neatly together, will repreſent an *Icoſihedron.*



Let A B C D E F G H I, be an Ichoſihedron, each Side of which is 12 Inches; the ſolid and ſuperficial Content is requir'd.

The Icoſihedron is compos'd of 20 triangular Pyramids, with their Vertices all joining in the Centre.

Therefore if the Solid Content of one Pyramid be multiply'd by 20, the Product is the whole Solid Content of the Icoſihedron.

10 . 39224
6

62 . 35344
20

1247 - 06880

The third Part of the Altitude of the Pyramid.

30230456
4435326

181382736
6046091
906914
151152
9069
1209
121

188 - 497292
20

3769 - 945840
The Solidity.

The ſuperficial Content
1147 - 0688.

A TABLE shewing the Solidity and superficial Content of any of the Regular Bodies, the Sides being 1 or Unity.

The Names of the Bodies	The Solidity	Superficies
Tetrahedron	0 - 1178511	1 · 732051
Octahedron	0 - 4714045	3 · 464102
Hexahedron	1 0000000	6 · 000000
Icosihedron	2 - 181695	8 · 660254
Dodecahedron	7 - 663119	20 · 645.729

By this Table the Content either Superficial or Solid, of any of these Bodies, may very readily be found; for all like Superficial Figures, are in Proportion one to another, as are the Squares of their like Sides; therefore it will be as the Square of 1 (which is 1) is to the Superficial Content in the Table, so is the Square of the Side of the like Body, to the Superficial Content of the same Body.

Therefore, if the Number in the Table be multiply'd by the Square of the Side given, the Product will be the Superficial Content requir'd.

All like Solids are in such Proportion to each other, as are the Cubes of their like Sides; therefore it will be as 1. (which is the Cube of 1.) is to the Solid Content in the Table, so is the Cube of the Side given to the Solid Content requir'd.

Therefore if the Number in the Table be multiply'd by the Cube of the given Side, the Product will be the Solid Content of the same Body.

JET D'EAU is a *French* Term, commonly us'd for a Fountain, which casts up Water to any considerable Height in the Air.

M. *Mariote* says a *Jet d'Eau* will never rise so high as its Reservatory; but always falls short of it by a Space, which is in a subduplicate Ratio of that Height; and this he proves by several Experiments.

He tells us also, that if a greater Branch is cut into many smaller Ones, or is distributed thro' several *Jets*, the Square of the Diameter of the main Pipe, must be proportioned to the Sum of all the Expences of its Branches, and particularly, that if the Reservatory be 52 Foot high, and the Adjutage half an Inch in Diameter, the Pipe ought to be 3 Inches in Diameter.

IMAGE [in *Opticks*] is the Appearance of an Object by Reflection or Refraction.

In all Plane Speculums, the Image appears of the same Magnitude as the Object, and as far behind the Speculum, as the Object is distant before it.

In Convex Speculums, the Image is farther distant from the Centre of the Convexity, than from the Point of Reflection, and the Image appears less than the Object.

IMPASTATION [in *Masonry*] a Term us'd for a Work made of Stuck or Stone, beaten and wrought up in Manner of a Paste.

IMPERFECT Numbers [in *Arithmetick*] are those whose Aliquot Parts taken together, don't make the just Number: but either come short of it, in which Case they are called *deficient Numbers*, or exceed it, and in this Case call'd *Abundant Numbers*.

IMPOSTS [in *Architecture*] are what are sometimes call'd Chaptrels; being the Parts on which the Feet of Arches stand.

These *Imposts* are conformable to their proper Orders. The *Tuscan* has only a *Plinth*; the *Dorick* has 2 Faces crown'd: the *Jonick* a Larmier or Crown over the two Faces, and its Mouldings may be carved; the *Corinthian* and *Composite* have a Larmier Freeze, and other Mouldings.

The Projectures of the *Imposts* must not exceed the naked of the Pilaster.

Sometimes the Entablature of the Order, serves for the *Impost* of the Arch, and this has a very grand and stately Appearance.

The *Impost* is a Thing very essential to the Composition of the Ordonnances, insomuch that without it, in the Place where the Curve Line of the Arch meets with the perpendicular Line of the Pillar, there always seems a kind of Elbow.

Mr. *Perrault* defines it the *Plinth of a little Cornish*, that crowns a Peer, and supports the first Stone, whence a Vault or Arch commences.

It derives its Name from the *Italian* Imposto, surcharg'd or burthen'd with, or laid upon.

M. *Le Clerc* defines Imposts to be little Cornishes, which terminate the Piedroits of Portico's, and are peculiarly appointed to receive the Extremes of their Arches, with their Archivolts or Head-Bands.

He tells us he usually proposes 2 Designs of Imposts, different in Height and Projecture; the lowest is for Portico's where the Columns have no Pedestals, and the other for Portico's where they have; that is, the little Imposts are for little Arches, and the large Imposts for large Ones; it being highly reasonable, that the Bigness of the Impost should be proportionable to that of the Portico.

He likewise observes, that Care must be taken that the Impost never exceed the Semi-Diameter of the Column behind; nor intercept any Thing of its roundness before.

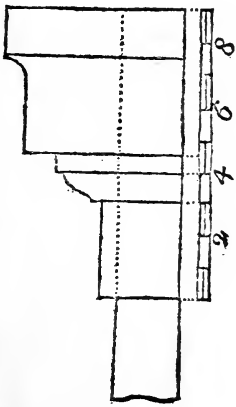
He adds that the most perfect Arches of the *Jonick* Order, are those which consist of a Semi-Circle; and the Imposts are most usually plac'd on a Level with the Centre.

However there are some Architects, who from an optical Consideration, place them a few Minutes

Minutes lower; and 'tis with Judgment they do it; for as the Projecture of the Impost hides a little Part of the Arch from the Eye, 'tis but reasonable, that it should be lower'd a little, to leave the intire Semi-Circle in View, which otherwise would not appear in View.

Some late Authors have given the following Rules for dividing the *Imposts* of *Arches*, by the Proportions of equal Parts; any Height being given (for either of them) is divided into Nine Parts.

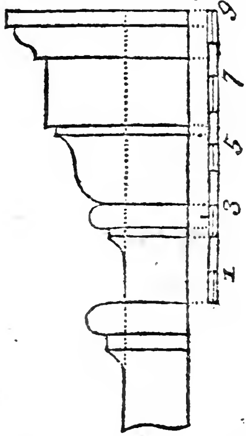
In the *Tuscan* Impost,



the Facia or Band hath 3, the Ogee 1, the Fillet $\frac{1}{2}$ a Part, the Corona 3, and the Band 1 $\frac{1}{2}$.

For the *Projections*, the Facia hath $\frac{1}{2}$ a Part, the Ogee 2, the Corona 3, and the whole 3 $\frac{1}{2}$. As in the Figure.

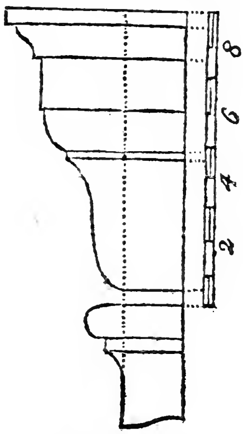
In the *Doric* Impost,



the Frize is 2, the Fillet $\frac{1}{4}$; the Astragal $\frac{3}{4}$, the Scima Recta 2 $\frac{1}{4}$, the Fillet $\frac{1}{4}$, the Corona 2, the Ogee 1, and the Fillet $\frac{1}{2}$ a Part.

For the *Projections*, the Fillet hath $\frac{1}{2}$ a Part, the Astragal 1, the Corona 2 $\frac{1}{2}$, and the Whole 3 $\frac{1}{2}$. As in the Figure.

In the *Jonic* Impost,



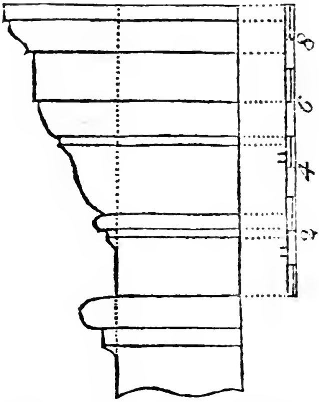
the Fillet hath $\frac{1}{2}$ a Part, the Scima 4, the Fillet $\frac{1}{4}$, the Ovolo 1 $\frac{1}{4}$, the Corona 1 $\frac{1}{2}$, the

 Ogee

Ogee 1, and the Fillet ½ a Part.

For the *Projections* the Scima hath 1 ¾, the Corona 2 ½, and the Whole 3 ½, as in the Figure.

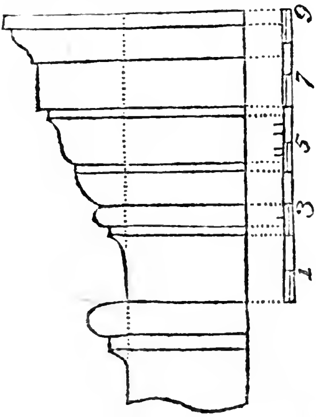
In the *Corinthian* Impost,



the Frize hath 1 ¾, the Fillet ¼, the Astragal ½ a Part, the Scima 2 ¼, the Fillet ¼, the Ovolo 1, the Corona 1 ½, the Ogee 1, and the Fillet ½ a Part.

For the *Projections*, the Fillet hath ¼, the Astragal ¾, the Scima 1 ¾, the Corona 2 ½, and the Whole 3½, as in the Figure.

In the *Composite* Impost,



the Frize hath 2, the Fillet ¼, the Astragal ¾, the Ovolo 1, the Fillet ¼, the Scima 1 ½, the Fillet ¼, the Corona 1 ½, the Ogee 1, and the Fillet ½ a Part.

For the *Projections*, the Fillet hath ¼, the Astragal ¾, the Ovolo 1 ½, the Scima 2 ¼, the Corona 2½, and the Whole, 3½. as in the Figure.

The *Collerino* of each of the last 4 Orders is 1 of these Parts, and the Fillet ½ a Part more.

For the *Projections*, the Fillet is ½ a Part, and the Whole 1 and ¼.

IMPROPER FRACTIONS [in *Arithmetick*] are such as have their Numerators equal to, or greater than their Denominators as $\frac{3}{3}$ $\frac{5}{3}$ &c. which are not properly Fractions, but either whole or mixt Numbers, and are only put into the Form of *Fractions*, in Order to be added, substracted, multiply'd or divided.

INCH is a known Measure, the twelfth Part of a Foot, containing the Space of three Barly Corns in Length.

INCIDENCE *Point* [in *Opticks*] is that Point in which a Ray of Light is suppos'd to fall on a Piece of Glass.

INCOMMENSURABLE *Numbers* [in *Arithmetick*] are such as have no common Divisor, that will divide them both equally, as 3 and 5.

INCOMMENSURABLE *Quantities* [in *Geometry*] are those, which have no aliquot Part, or any common Measure that may measure them, as the Diagon

Diagonal and the Side of a Square; for altho' that each of these Lines have infinite aliquot Parts, as the half the Third, &c. yet not any Part of the one being ever so small, can possibly measure the other, as is demonstrated by *Euclid*. III. 117. El. 10. but yet is commensurable in Power.

INCOMPOSITE Numbers are the same with those *Euclid* calls Prime Numbers.

There is a Table of Incomposite Numbers in Dr. *Pell*'s Edition of *Brancher*'s *Algebra*, which not only gives an orderly Enumeration of all odd Numbers, which are not Composite; but it shews also that none of the Rest are so. This Table being useful, the Reader may have Reference to it.

INDETERMINED PROBLEM is one which is capable of an infinite Number of Answers, as to find 2 Numbers, whose Sum together with their Product shall be equal to a given Number, or to make a Rhomboides such, that the Rectangle under the Sides be equal to a given Square; both of which Problems, will have infinite Solutions.

INDIGO is a dark blue if work'd by it self; but it is usually mix'd with white to remedy this; and then it makes but a very faint blue; this Colour is the Tincture of a Vegetable call'd by that Name, and also *Anil*, and grows in both the West and East *Indies*, the Leaves of which being put into wooden Cisterns fill'd with Water, are often stirr'd violently, till the greatest Part be reduc'd to a Slime or Mucilage, which being separated from the Water, when sunk to the Bottom and dry'd, produces that Substance, which is by us call'd *Indigo*.

Indigo will grind very fine, and lie with a good Body, and is very much us'd in vulgar Painting.

Note, That the longer this Colour is ground, the more beautiful and fair it will look.

INDIVISIBLES [in *Geometry*] are such Elements or Principles as any Body or Figure may ultimately be resolv'd into: And these Elements or Indivisibles are in each peculiar Figure suppos'd to be infinitely small.

1. With Regard to which Notion, a Line may be said to consist of Points, a Surface of Parallel Lines, and a Solid of Parallel and Similar Surfaces: and then because each of these Elements is suppos'd to be indivisible, if in any Figure a Line be drawn thro' the Elements perpendicularly, the Number of Points in that Line, will be the same Number of Elements.

2. Whence we may see, that a *Parallelogram*, *Prism* or *Cylinder* is resolvable into Elements or Indivisibles, all equal to each other, parallel and like to the Base, a *Triangle* into Lines parallel to the Base, but decreasing in Arithmetical proportion, and so are the Circles which constitute the Parabolick Conoid, and those which constitute the Plane of a Circle or the Surface of an Isosceles, Cone.

3. A *Cylinder* may be resolv'd into Cylindrical Curve Surfaces, having all the same Height and continually decreasing inwards.

If a finite Quantity be divided by an infinitely small one, the Quotient will be an infinitely great one: and if a finite Quantity be multiply'd by an infinitely small one, the Product will be an infinitely small one.

But if by an infinitely great One, the Product will be an finite Quantity.

If an infinitely small Quantity be multiply'd or drawn into an infinitely great one, the Product will be a finite one.

INFINITELY INFINITE FRACTIONS, a Term us'd when all the Fractions, whose Numerator is 1. are together equal to an Unite; And hence it is deduc'd, that there are not only *infinite* Progressions, or Progressions *in infinitum*, but also *infinitely* farther than one Kind of Infinity.

That these infinitely infinite Progressions are notwithstanding computable, and to be brought into one Sum; and that not only finite; but into one so small, as to be less than any assignable Number: That of infinite Quantities Some are equal, others unequal: That one infinite Quantity may be equal to 2 or 3 or more Quantities, whether finite or infinite.

INFINITE or INFINITELY great QUANTITY, is that which has no Bounds, Ends or Limits.

INFINITELY SMALL QUANTITY, is that which is so very small, as to be incomparable to any finite Quantity, or which is less than any assignable Quantity.

1. No infinite Quantity can be augmented or lessen'd by adding to or taking from it a finite Quantity: Neither can a finite Quantity be augmented or lessen'd by adding to, or taking from it an infinitely small Quantity.

2. If there be 4 Proportionals, and the First is infinitely greater than the Second, then the Third must be infinitely greater than the Fourth.

INORDINATE PROPORTION is when the Order of Terms is disturb'd; as supposing 3 Magnitudes in one Rank, and 3 other proportional to them in another, and you compare them in a different Order; as suppose there are in one Rank these three Numbers 2, 3, 9; and in another Rank these other three 8, 24, 36; Proportional to the Precedent in a different Order, so that 2 shall be to 3 as 24 to 36, and 3 to 9 as 8 to 24, then casting away the mean Terms in each Rank conclude the first 2 in the first Rank is to the last 9, as 8 the first of the other Rank to the last 36.

INSCRIBED [in *Geometry*] a Figure is said to be inscrib'd in another, when all the Angles of the Figure inscrib'd touch either the Angles, Sides, or Planes of the other Figure.

INSULATED [*Insulatus*] is a Term apply'd to a Column that

that ſtands alone, or free from any contiguous Wall, *&c.* like an Iſland in the Sea. The *French* call it *Iſolee.*

INTACTÆ are right Lines, to which curves do continually approach and yet never meet with them; theſe are uſually called *Aſymptotes.*

INTERCOLUMNIATION [in *Architecture*] is the Space between two Columns, which in the *Dorick* is regulated according to the Diſtribution of Ornaments in the Frieze; but in the other Orders, according to *Vitruvius*, is of five different Kinds, *viz.* *Picnoſtyle*, *Syſtyle*, *Euſtyle*, *Diaſtyle* and *Aræoſtyle.* This is by the *Latins* call'd *Intercolumnium.*

M. *Le Clerc* ſays, that where the Columns of the *Tuſcan* Order are without Pedeſtals, and without Porticoes too, there are three ſeveral Spaces or Diſtances, at which they may be plac'd, *viz.* a large, a mean, and a little Diſtance.

The firſt and ſecond ſhew the greateſt and leaſt Space, which can be reaſonably interpos'd between the Columns of the Order, when they follow each other one by one; and the third ſhews how near they may be plac'd, when they are to follow each other 2 by 2.

When thoſe Columns ſtand 2 by 2, between each Pair the greateſt Diſtance muſt be made, which is 9 Modules, reckoning from the Axis of the one to that of the other.

When they follow each other 1 by 1, the Interval ought not to exceed 4 Modules, 20 Minutes, from one Axis to the other.

It is not, he ſays, however to be ſuppos'd that theſe Proportions are ſo preciſe, as that they may not be varied a few Minutes when Occaſion ſhall require; but this muſt be obſerv'd, that the leſs the Variation is, the better 'twill be.

In the	*Tuſcan*	The Intercolumniation muſt be	4	Diameters of the Body of the Column below.
	Dorick		3	
	Ionick		2	
	Corinthian		$2\frac{1}{4}$	
	Compoſite		$1\frac{1}{2}$	

The INTERCOLUMNS of the *Ionick* Order, M. *Le Clerc* ſays, that the Diſtances of this Order are adjuſted by a certain Number of Denticles, which leave a convenient Space between them; with this Circumſtance; that there is always found one in the Middle of each Column.

Thus, he ſays, when he mentions 35 Denticles between the Axes of the Columns, it is to be underſtood that there are 24 whole ones, and 2 halves, one at each Extream; the firſt *Denticles* and the laſt each being cut into 2 equal Parts by the Continuation of the Axis of the Columns.

Whence it may be obſerv'd, that in caſe there be a Neceſſity for

for augmenting or diminiſhing the Inter-columns, it muſt be done by augmenting or diminiſhing the Number of theſe *Denticles*, which however, ought never to exceed 1 or 2 *Denticles* at the moſt.

In the *Roman Order.* As in the *Ionick Order*, the Diſtances of the Columns are to be adjuſted by a certain Number of Denticles; ſo, he ſays, in this Order, they muſt be adjuſted by a certain Number of Modillions; with this Reſtriction, that there be always one exactly in the Middle between each Column.

The Inter-Modillions having been at firſt regulated by the Diſtance, that ought to be between the two Columns.

INTERSECTION [in *Mathematicks*] the cutting of one Line or Plane by another; thus we ſay, that the mutual Interſection of 2 Planes is a right Line.

INTERTIES } [in *Architecture*]
INTERDUCES }
are thoſe ſmaller Pieces which lie Horizontally between the Sommers, or between them and the Sell and Raiſon.

INTERVAL *Of the Fits of eaſy Reflection, and of eaſy Tranſmiſſion of the Rays of Light.* Is the Space between every Return of the Fit and the next Return. Theſe Intervals Sir *Iſaac Newton* ſhews how to collect, and thence to determine whether the Rays ſhall be reflected or tranſmitted at their ſubſequent incidence on any pellucid Medium.

INVERSION an Action by which any Thing is inverted or turn'd backwards. Problems in Geometry and Arithmetick are often proved by *Inverſion* or making a contrary Rule or Demonſtration.

JOBENTS, ſee *Nails*.

JOINT [in *Architecture*] is the Separation between the Stones, which is filled with Mortar, Plaiſter or Cement.

JOINT [in *Carpentry*, &c.] ſignifies the ſeveral Manners of Aſſembling of Pieces of Wood together, as a Dovetail-Joint, *&c.*

JOINT RULE, ſee *Rule*.

JOGGLE PIECE, ſee *Crown Poſt*.

JOISTS [in *Architecture*] are thoſe Pieces of Timber fram'd into the Girders and Summers, on which the Boards of the Floors are laid.

Scantlings of Joiſts, at full Length (to bear in the Wall)

Being	12 Foot	ought to be in their Squares.	8 Inches and 3 Inches
	11 Foot 6 Inches		7 Inches and 3 Inches
	10 Foot 6 Inches		6 Inches and 3 Inches

And binding or trimming Joiſts.

Being in Length	7 Foot	Ought to be in their Squares	6 Inches and 5 Inches
	9 Foot		7 Inches and 5 Inches
	11 or 12 Foot		8 Inches and 5 Inches

1. *Their*

1. *Their Distance and Position*]. 1. No Joists ought to lie at a greater Distance from each other, than 10 (or at most than 12) Inches.

2. All Joists on the Back of a Chimney, ought to be laid with a Trimmer, at 6 Inches Distance from the Back.

3. No Joists ought to bear at a longer Length than 10 Foot

4. No Joists ought to lie less than 8 Inches into the Brick-Wall.

5. Some Carpenters furr their Joists (as they call it) that is, they lay 2 Rows of Joists one over another; the undermost of which are fram'd Level with the under side of the Girder, and the uppermost (which lie cross the lower ones) lie Level with the upper side of the Girder.

JOINERY, the Art of working in Wood, or of fitting and assembling various Parts or Members together: It is call'd by the *French Menuiserie* q. d. Small Work, by which it is distinguish'd from *Carpentry*, which is conversant in larger and less curious Works.

Joiners Work.

JOINERS measure their Work by the Yard Square; but they take their Dimensions differently from others; for they have a Custom so to do, saying, *they ought to measure where the Plane touches*; and therefore in taking the Height of any Room, about which there is a Cornish, and swelling Pannels and Mouldings; they with a String begin at the Top, and girt over all the Mouldings; which will make the Room to measure much higher than it is; and as for measuring about the Room, they only take it as it is upon the Floor.

Example 1. If a Room of Wainscot being girt downwards over the Mouldings) be 15 Feet 9 Inches high, and 126 Feet 3 Inches in Compass, how many Yards are contain'd in that Room?

Multiply the Compass by the Height, and the Product will be 1988 Feet, 5 Inches, 3 Parts; which being divided by 9, gives 220 Yards, and 8 Feet, the Answer.

Feet	Inches.	
126	3	
15	9	
630		
126		
63	1	6
31	6	9
3	9	0
9) 1988	5	3

Answer 220 : 8 F2.

```
   126 : 25
    15 : 75
   --------
     63125
    88375
   63125
  12625
  ---------
9) 19884375
  ---------
   220 : 8
```

Example

Example 2. If a Room of Wainscot be 16 Feet 3 Inches high (being girt over the Mouldings) and the Compass of the Room is 137 Feet 6 Inches, how many Yards does it contain.

Multiply 137 Feet 6 Inches, by 16 Feet 3 Inches, and the Product will be 2234 Feet, 4 Inches 6 Parts, which being divided by 9, the Quotient will be 248 Yards, and 2 Feet.

	F.		I.		
	137	:	6		
	16		3		
	830				
	137				
	34	:	4	:	6
9)	2234	:	4	:	6
	248	:	2	:	0

	137.5
	162.5
	6875
	2750
	8250
	1375
9)	2234.375
	248 2

Facit 248 Yards, 2 Feet.

2. Joiners Work, or Wainscotting.

By Scale and Compass.

For the *First Example*, Extend the Compasses from 9 to 126,25 and that Extent will reach from 15, 75, to 220, 9 Yards.

For the *Second Example*, Extend the Compasses from 9 to 137,5 and that Extent will reach from 16,25 to 248 Yards and about a Quarter.

In Joiner's Work it is to be observ'd, and that in measuring of Doors and Window-Shutters, and all such Work as is wrought on both Sides, they are paid for Work and half Work; so that in measuring all such Work, the Content is first to be Found, as before, and half that Content must be added to it; and that Sum so added, will be the Content at Work and Half.

Example. If the Window-Shutters about the Room be 69 Feet 9 Inches broad, and 6 Feet 3 Inches high, how many Yards do they contain at Work and Half.

Multiply 69 Feet 9 Inches by 6 Feet 3 Inches, and the Product will be 435 Feet 11 Inches 3 Parts; the Half of which is 217 Feet 11 Inches 7 Parts; which being added together, the Sum will be 653 Feet 10 Inches and 10 Parts; which being divided by 9, the Quotient will be 72 Yards 5 Feet, the Content at Work and Half.

F.	I.
69 -	9
6 -	3
418 -	6
17 -	3
435 -	11 - 3
217 -	11 - 7
9)653 -	10 - 10
72 - 5	

Facit 72 Yards, 5 Feet

69 . 75
6 . 25

34875
13250
41850

435 . 9375
217 . 9687

635 . 9062

By Scale and Compass.

Extend the Compasses from 9 to 69 . 75, and that Extent will reach from 6 . 25 to 48 . 4 Yards; the Half of which is 24 . 2, which being added together make 72 . 6 Yards, the Content at Work and Half.

Note, That Deductions are to be made for all Window-Lights; but Window-Boards Sopheta Boards and Cheeks, must be measured by themselves.

IONICK ORDER [in *Architecture*] is the third of the five Orders, and is a Kind of mean between the strong and delicate Orders. Its Capital is adorn'd with Volutes, and its Cornish with Denticles.

The Proportions of this Pillar as they are taken from the famous one in the Temple of *Fortuna Virilis* at *Rome*, now the Church of St. *Mary* the *Ægyptian* are these.

1. The *Entire Order*, from the Superficies of the Area to the Cornice are 22 Modules, or 11 Diameters.

2. The *Column* with its Base contains 18 Modules.

3. The Entablature (i. e. the *Architrave*, *Frieze* and *Cornice*) contains 4 Modules.

4. The *Volute* of the Capital is of an Oval Form.

5. The Columns in this Order are often hollowed and furrowed with 24 Gutters, or Channels, call'd Flutes, these Flutings are not always Concave from the top of the Shaft to the bottom; but for that third of it next the Base, are fill'd up with a Kind of Rods or Canes, by the *French* call'd *Batons*, and in the other 2 thirds are left hollow, or striated in imitation of the Folds or Plaits of a Garment.

The first Idea of this Order was given by the People of *Jonia*, who according to *Vitruvius* form'd it on the Model of a young Woman, dress'd in her Hair, and of an elegant Shape; whereas the *Dorick* had been form'd on the Model of a strong, robust Man.

The *Jonick* Order is distinguish'd from the *Composite* in that it has none of the *Acanthus* Leaves in its Capital, and from

from the *Tuscan* and *Dorick* too, by the Channels or Fluting in its Shaft.

When this Order was first invented, its Height was but 16 Modules; but the Ancients to render it still more beautiful than the *Dorick*, augmented its Height by adding a Base to it, which was unknown to the *Dorick*.

M. *Le Clerc* makes its Entablement 4 Modules & 10 Minutes, and its Pedestal 6 intire Modules; so that the whole Order makes 28 Modules 10 Minutes.

It is said, that the Temple of *Diana* at *Ephesus*, the most celebrated Edifice of all Antiquity, was of this Order.

This Order is at present us'd properly in Churches and religious Houses, Courts of Justice, and other Places of Tranquillity and Devotion.

This Order has one Advantage above any of the Rest which consists in this, that the fore and hind parts of its Capital are different from its Sides; but this is attended with an Inconvenience, when the Ordonnance is to turn from the Front of the Building to the Side: To obviate which the Capital may be made Angular, as is done in the Temple of *Fortuna Virilis*.

Scamozzi and some other modern Architects have introduc'd the upper Part of the *Composite* Capital in Lieu of the *Ionick*; imitating that of the *Temple of Concord*, the 4 Sides of which are alike, in Order to render it more beautiful, the Volute may be made a little more Oval and inclining.

The Proportions of the *Ionic* Order by equal Parts, are given by some late Authors as follows.

The whole Height is divided into 13 Diameters and a half; the Pedestal having two and two thirds, the Column nine, and the Entablature one and four fifths.

The Height of the *Pedestal* being 2 Diameters and $\frac{2}{3}$, is divided into 4, giving 1 to the Base, whose Plinth is $\frac{2}{3}$ thereof, the other Part is divided into 8, giving 1 to the Fillet, 4 to the Cymase, 1 to the Fillet, and 2 to the Hollow, the breadth of the Die, is 1 Diameter and $\frac{1}{3}$, and the *Projection* of the Base is equal to its Height, the upper Fillet hath 3 of these Parts, and the lower Fillet 7; the Height of the Cornice is half the Base, being $\frac{1}{8}$ of the whole Height, and is divided into 10, giving 2 to the Hollow, 1 to the Fillet, 4 to the Corona, 2 to the Ogee, and 1 to the Fillet; the *Projection* of the Hollow hath 3 of these Parts, the Corona 6, and the whole 8.

The *Base* of the Column, the Height is $\frac{1}{2}$ a Diameter, and is divided into 6, giving 1 and $\frac{3}{4}$ to the Plinth, 1 and $\frac{1}{4}$ to the lower Torus, $\frac{1}{4}$ to the Fillet, 1 to the Scotia, $\frac{1}{4}$ to the Fillet, 1 to the upper Torus, and $\frac{1}{2}$ a Part to the Bead [b] at Top; the Fillet above the Bead is equal to the others, and is Part of the Column; the *Projection* is 2 of these Parts, $\frac{1}{2}$ thereof is for the

the upper Fillet, and $\frac{2}{3}$ for the upper Torus; the Scotia is form'd by the Rule shewn in the *Doric*.

The DIMINISHING of this Column, is $\frac{1}{8}$ of the Diameter.

For the *Capital*, divide the Diameter into 9 Parts, and 4 and $\frac{3}{4}$ is the whole Height, giving 1 and $\frac{1}{4}$ from the bottom of the Volutes [c] to the Fillet, $\frac{1}{4}$ to the Fillet, $\frac{1}{2}$ a Part to the Astragal[d], 1 to the Ovolo [e], $\frac{3}{4}$ to the Volute, $\frac{1}{4}$ to the Rim [f], $\frac{1}{2}$ a Part to the Ogee, and $\frac{1}{4}$ to the Fillet.

The *Projection* of the Ogee is 1 of these Parts. For forming the *Volute* describe a Circle in the Centre of the Astragal, equal to the Height thereof, and make the Divisions into 3, as is shewn in the Figure A, then placing one foot of the Compasses in the Centre marked 1, extend the other to the top of the Rim, and describe a quarter of a Circle, and removing the foot into the Centre 2, describe another Quarter, and so proceeding to all the rest as they are marked. For the *Diminishing* of the *Rim*, each Distance between the Centres is divided into five, and the nearest Division within the old ones, is the new Centre for the same.

The Height of the *Entablature* being 1 Diameter and $\frac{4}{5}$ is divided into 6, 2 are for the Architrave 1, and $\frac{1}{2}$ for the Frize, and 2 $\frac{1}{2}$ for the Cornice.

The *Architrave* is divided into 9, giving 1 and $\frac{3}{4}$ to the first Face, 2 and $\frac{1}{2}$ to the second, and 3 to the third, 1 and $\frac{1}{4}$ to the Ogee, and $\frac{1}{2}$ a Part to the Fillet: The *Projection* of the 2d and 3d Faces have a $\frac{1}{4}$ of a Part each, and the Whole 2 of these Parts.

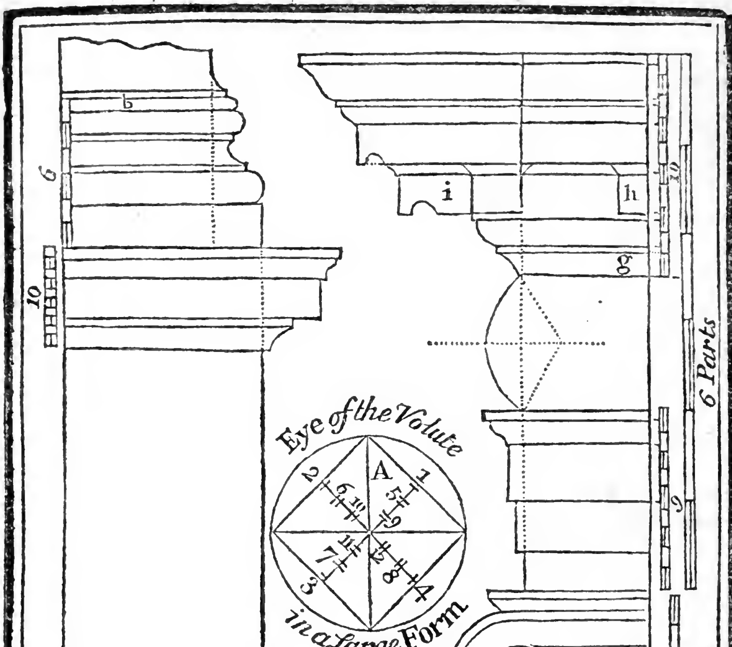
The *Frize* is formed with such a Part of the Circle which answers to the Naked and Projection of the Architrave.

The *Cornice* is divided into 10 Parts, giving 1 to the Cavetto [g], $\frac{1}{4}$ to the Fillet, 1 and $\frac{1}{4}$ to the Ovolo, $\frac{1}{4}$ to the Fillet, a and $\frac{3}{4}$ to the Modillions, [h], $\frac{1}{2}$ 1 Part to the Caps, 1 and $\frac{3}{4}$ to the Corona, $\frac{3}{4}$ to Scima Reversa, $\frac{1}{4}$ to the Fillet, 1 and $\frac{3}{4}$ to the Scima Recta, and $\frac{1}{2}$ a Part to the Fillet.

For the *Projections* the Hollow has 1 of these Parts, the Ovolo 2; the breadth of the *Modillion* is $\frac{1}{6}$ of the Diameter, and the inside is Perpendicular to the Naked of the Column at top, and one being in the middle, gives the Space between; the Return'd one [i] projects 5 and $\frac{1}{2}$, the Cap 6, the Corona 7 and $\frac{1}{2}$, the Scima Reversa 8$\frac{1}{4}$, and the Whole 10, being equal to the Height.

The

The Proportions of the Ionic *Order, by equal Parts.*



IRON is a hard fusible and malleable Metal, of vast Use in Building, and many other Affairs in Life.

It consists of an Earth, Salt, and Sulphur; but all impure, ill mix'd and digested, which renders it very liable to Rust.

It is the hardest, driest, and most difficult to be melted of all Metals.

It may be softened, by heating it often in the Fire, hammering it, and letting it cool of it self; and is hardned by extinguishing it in Water.

It may be rendered white by cooling it in Sal Armoniac and quick Lime.

The strongest Temper of *Iron*, is said to be that, which it takes in the Juice of strain'd Worms.

Iron has a great Conformity with Copper, so that they are not easily separated when soldred together.

Iron has also a great Conformity with the Loadstone. *Rohault* says, that it is it self an imperfect Loadstone, and that if it be a long Time exposed in a certain situation, it becomes a real Loadstone, and mentions the Iron in the Steeple of *Notre-Dame* at *Chartres* as an Instance.

[The *Kinds of Iron.*] There are several Kinds of Iron that have Properties very different from one another; as,

1. *English*, Which is coarse, hard and brittle, fit for Fire Bars, and other such coarse Uses.

2. *Swedish Iron*, which of all others, is the best, us'd in *England*. It is a fine, tough sort of Iron, which will best endure the Hammer, is softest to File, and in all Respects the best to Work upon; and therefore most coveted by Workmen.

3. *Spanish Iron*, which would be as good as the *Swedish*, were it not subject to *Red-Sear*, (as Workmen phrase it) that is, to crack between hot and cold; therefore when it falls under your Hands, you must tend it more diligently at the Forge. But tho' it be a good, tough, soft Iron, yet Workmen refuse it for many Uses, because 'tis so ill and unevenly wrought in the Bars, that it costs them a great Deal of Labour to smooth it; but it is good for all great Works, which require Welding, as the Bodies of Anvils, Sledges, large Bell-Clappers, large Pestles for Mortars, and all thick strong Bars, &c. But it is particularly chosen by Anchor Smiths, because it abides the Heat better than other Iron, and when 'tis well wrought, is the toughest.

4. *German Iron*, which goes by the Name of *Dort Square*, because it is brought hither from thence, and is wrought into Bars of 3 Quarters of an Inch Square; this is a bad, coarse Iron, and only fit for ordinary Uses, as Window-Bars, Brewers Bars, Fire Bars, &c.

5. There is another Sort of Iron for making of Wire, which is the softest and toughest of all Iron. This Sort is not peculiar to any Country; but is indifferently made, wherever Iron is

made, tho' of the worst Sort; for 'tis the first Sort that runs from the Mine Stone, and is reserv'd purely for the making of Wire.

To know good Iron.] Generally speaking, the best Iron is the softest and toughest, and that which when it breaks is of an even greyish Colour, without any of those glittering Specks, or any Flaws or Divisions, like to those seen in broken Antimony.

Therefore when you chuse it, chuse such as bows oftenest before it breaks, which is an Argument of toughness, and see that it breaks sound within, of a greyish Colour, &c. And that there be no Flaws or Divisions in it; for these are Arguments that 'tis sound, and has been well wrought at the Mill.

To give Iron a true blue Colour.] Rub off the black Scurf with a Grind-Stone or Whet-Stone, rubbing hard upon the Work: then heat it in the Fire, and as it grows hot, it will change the Colour by Degrees, becoming first of a light Gold Colour, then of a darker Gold Colour, and then of a beautiful Blue. But sometimes Work-men Grind Indigo and Sallad-Oil together, and rub tha Mixture upon it with a Woollen Rag, while it is heating, and let it cool of it self.

Of Twisting Iron.] Square and flat Bars of Iron are sometimes (by Smiths) twisted for Ornament, which is very easily done, and the Manner of doing it is as follows: After the Bar is square or flat forged (and if the Curiosity of the Work require it, truly fil'd) they give it a *Flame Heat*; or if the Work be small, but a *Blood red Heat*, and then it is easily twisted about as much or as little as they please, with the Tongues, Vice, or the like.

The Price of Iron when wrought.] Iron being wrought by the Smith into Dogs, Bars, Staples, large Hooks, Hinges, Grates, &c. the usual Price is $3\frac{1}{2}$*d.* or 4*d. per* Pound: But for small and neat Hooks, Hinges, Bolts, Staples, &c. various, as from 4*d.* to 8*d. per* Pound.

The several Heats which the Smiths give their Iron in working are,

1. A *Sparkling* or *Welding Heat*, which is used when they double up their Iron, or weld 2 Pieces of Iron together End to End.

2. A *Flame* or *White Heat*, which is us'd when the Iron has not its Form or Size, but must be forg'd into both.

3. *Blood Red Heat*, which is used when the Iron has already its Form and Size, but wants a little Hammering to smooth and fit it for the File.

If the Iron be made too Hot, it will red-sear, *i. e.* break or crackle under the Hammer while it is working between hot and cold.

IRON-MOULDS, are certain Yellow Lumps of Earth or Stone, found in Chalk-Pits, about the *Chiltern* in *Oxfordshire*, which are really a Kind of indigested Iron Ore.

IRON-ORES } IRON-WORKS } Of these we have a great Number in most Parts of *England*; but those in the *Forest of Dean* in *Glocestershire*, are in the most Repute.

The Ore is there found in great Abundance, differing much in Colour, Weight, and Goodness.

The best, which is called *Brush Ore*, is of a Blueish Colour, very ponderous, and full of little shining Specks, like Grains of Silver: This affords the greatest Quantity of Iron; but being melted alone, produces a Metal very short and brittle, and therefore not so fit for common Use.

In Order to remedy this Inconvenience, the Workmen use another Sort of Material call'd *Cinders*, which is no other than the Refuse of the *Ore*, after the Metal has been extracted; and which being mingled with the other in due Quantity, gives it an excellent Temper of Toughness, which makes this *Iron* to be preferred before any other brought from Foreign Parts.

After the Ore is Provided, the first Work is to Calcine it, which is done in Kilns, much after the Fashion of our Common Lime Kilns; which are filled up to the Top with Coal and *Ore*, *Stratum super Stratum*, i. e. Layer upon Layer; and then setting Fire to the Bottom, they let it burn 'till the Coal is wasted, and then renew the Kiln with fresh Ore and Coals, in the same Manner as before.

This is perform'd without fusing the Metal, and serves to consume the more drossy Part of the *Ore*, and to make it malleable, supplying the beating and washing that are us'd in other Metals.

From thence they carry it to the Furnaces, which are built either of Brick or Stone, about 24 Foot Square on the outside, and near 30 Foot in Height within: not above 8 or 10 Foot over where it is the widest, which is about the middle; the Top and Bottom having a narrow Compass, much like the Shape of an Egg.

Behind the Furnace are fix'd 2 Pair of Bellows, the Noses of which meet at a little Hole near the Bottom; these are compress'd together by certain Buttons, plac'd on the Axis of a very large Wheel, which is turn'd about by Water, in the Manner of an overshot Mill.

As soon as these Buttons are slid off, the Bellows are rais'd again by the Counterpoise of Weights, whereby they are made to play alternately, the one giving its Blast, the time the other is rising.

At first, these Furnaces are fill'd with *Ore* and Cinder intermix'd with Fuel, which in these Works is always of Charcoal, laying them hollow at the Bottom, that they may take Fire more easily; but after they are once kindled, the Materials run together into a hard Cake or Lump, which is sustain'd by the Fashion of the Furnace; and through this the Metal, as it were, meets, trickles

down into the Receivers ſet at the Bottom, where there is a Paſſage open, by which the Men take away the Scum and Droſs, and let out the Metal, as they ſee Occaſion.

Before the Mouth of the Furnace lies a great Bed of Sand, where they make Furrows of the Shape into which they would have the Iron caſt.

As ſoon as the Receivers are full, they let in the Metal, which is rendred ſo very fluid by the Violence of the Fire, that it not only runs to a conſiderable Diſtance, but ſtands afterwards boiling for a good while.

When the Furnaces are once ſet to work, they are kept conſtantly employ'd for many Months together, the Fire not being ſuffer'd to ſlacken Day nor Night, but is kept ſtill ſupply'd with Fuel and other Materials poured on at Top as the other waſtes. The Coal us'd in this Work is altogether Charcoal, for Sea-Coal will not do.

The Workmen bring their Sows and Pigs of Iron from theſe Furnaces to the Forges, where they are wrought into Bars.

IRRATIONAL Numbers are the ſame as *Surd Numbers*.

IRREGULAR BODIES, are ſuch Solids as are not terminated by equal and regular Surfaces.

IRREGULAR COLUMN [in *Architecture*] is one which does not only deviate from the Proportions of any of the 5 Orders; but whoſe Ornaments, whether in the Shaft or Capital, are abſurd and ill choſen.

ISAGON [in *Geometry*] is ſometimes us'd for a Figure, conſiſting of equal Angles.

ISLES [in *Architecture*] are the Sides or Wings of a Building.

ISOCHRONE *Vibrations* of a Pendulum, are ſuch as are made in the ſame Space of Time, as all the Vibrations or Springs of the ſame Pendulum are; whether the Ark it deſcribes be longer or ſhorter; for when it deſcribes a ſhorter Ark, it moves ſo much the ſlower, and when a long one, proportionably faſter.

ISOCHRONAL LINE, is that in which a heavy Body is ſuppos'd to deſcend without any Acceleration.

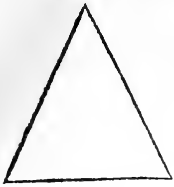
ISOPERIMETRICAL Figures [in *Geometry*] are ſuch as have equal Perimeters or Circumferences.

1. Of *Iſoperimetrical regular Figures*, that is the greateſt that contains the greateſt Number of Sides, or moſt Angles, and conſequently a Circle is the greateſt of all Figures that have the ſame Ambit as it has.

2. Of 2 Iſoperimetrical Triangles, having the ſame Baſe, whereof 2 Sides of one are equal, and the other unequal, that is the greater, whoſe Sides are equal.

3. Of Iſoperimetrical Figures whoſe Sides are equal in Number, that is the greateſt which is equilateral and equiangular.

ISOSCELES TRIANGLE is a Triangle that hath 2 Sides, or Legs equal to one another, and the third Side or Baſe unequal; as in the Figure.



JUFFERS [with *Carpenters*] a Term us'd for Stuff, about 4 or 5 Inches Square, and of ſeveral Lengths.

K.

KERF is the ſawn away ſlit in a Piece of Timber or Board; or the Way made by the Saw, is call'd a Kerf.

KEY-STONE, See *Arch*.

KEYS for Doors are of various Prices, according to their Size and Workmanſhip, Maſter Keys *per* piece; 2 or 3 *s*.

KEYS [in *Maſonry*] that have a Projecture, and are made in Manner of Conſoles, and plac'd in the middle of Arches or Portico's, are particularly deſign'd to ſuſtain the Weight and Preſſure of the Entablature, where it happens to be very great between the Columns; for this Reaſon they ought to be made in ſuch Manner, as that they may prove a real Support, and not ſtand for mere Ornaments, as they frequently do. Without this Precaution, M. *Le Clerc* ſays, he thinks they had better be intirely omitted.

KING-PIECE, See *Crown-Poſt*.

KNEE, a Piece of Timber cut crooked with an Angle, is call'd a *Knee-Piece* or *Knee-Rafter*.

L.

LABEL, is a long, thin braſs Ruler, with a ſmall Sight at one End, and a Center Hole at the other; commonly us'd with a tangent Line to the Edge of a Circumferentor for taking Altitudes, &c.

LABORATORY, a Place where Chymiſts Furnaces are built, their Veſſels kept, and their Operations perform'd.

LABYRINTH, a large intricate Edifice, cut out into various Iſles, Meanders, running into one another, ſo as to render it difficult to get out of it.

There is mention made of four celebrated Labyrinths of Antiquity; that of *Crete* is the moſt famous, built by *Dædalus*, out of which *Theſeus* is ſaid to have made his Eſcape by Means of *Ariadne*'s Crew.

2. That of *Egypt*, which according to *Pliny* was the oldeſt of all, and was ſtanding in his Time, having ſtood 3600 Years, which, *Herodotus* ſays, was the Work of ſeveral Kings, but *Pliny* aſcribes it to King *Peteſucus* or *Titheos*. It ſtood on the Banks of the Lake *Myris*, and conſiſted of 12 Palaces and 1500 Apartments; *Mela* ſays 3000 Houſes.

3. That of *Lemnos*, which was ſupported by Columns of wonderful Beauty, of which there were ſome Remains in *Pliny*'s Time.

4. That of *Italy*, built by *Porſenna* King of *Hetruria* for his Tomb.

LACUNAR [in *Architecture*] an arched Roof or Ceiling, more eſpecially the Planking or Flooring above the Portico's and Piazza's.

LAKE, eſpecially the richeſt Sorts, is the beſt of all dark Reds, being a moſt pure crimſon; 'tis a Colour that will grind very fine, and lies with a good Body; but there muſt be much Pains taken in grinding it; for if it be not well and thoroughly ground, its Colour will want much of its Glory; and beſides this, 'twill work with ſome Difficulty; being apt to cling together like a Jelly, after 'tis laid on; juſt as warm Water does upon a greaſy Trencher, when it is waſh'd in it; to prevent which, it muſt be well ground, and tempered as thin, as it can well be work'd.

There are ſeveral Sorts of *Lake* ſold at the Colour Shops, very different, ſome being of a more dead and pale Colour.

It is made of the Tincture of a Vegetable, which ſtains red; but of what, or how done, I have not yet perfectly learn'd: the beſt Sorts of it come from *Venice* and *Florence*.

LANTHORN [in *Architecture*] a Sort of little Dome rais'd over the Roof of a Building to give Light, and to ſerve for a *Corona*, or to finiſh the Building; the Term is alſo us'd for a ſquare Cage of Carpentry, with Glaſs in it, placed over the Ridge of a Corridor or a Gallery, between 2 Rows of Shops, to illumine them, as that in the *Royal Exchange*, *London*.

LARMIER [in *Architecture*] A flat, Square, maſſive Member of the Cornice, between the *Cymatium*, and the *Ovolo*, and jets out fartheſt, being ſo call'd from its Uſe, which is to diſperſe the Water, and cauſe it to fall at a Diſtance from the Wall, drop by drop, or as it were, by Tears, *Larme* in *French* ſignifying a Tear; the *Larmier* is alſo call'd *Corona*.

LATCHES *for Doors* are of various Kinds and Prices; common Iron Latches *per* piece, *6d.* larger, *8d.* and *10d.* Long varniſh'd Latches, at about *10d.* *per* piece, Rim'd Latches with a ſliding Bolt, *2s.* *per* piece. Spring Latches, 1 or 1*s.* and *6d* per piece.

LATHS [for Building] long thin and narrow ſlips of Wood, us'd in Tiling or Walling; theſe are diſtinguiſh'd into 3 Kinds, according to the different Woods they are made of, *viz.* Heart of Oak, Sap-Laths, and Deal-Laths; the 2 laſt Sorts are us'd for Ceilings and Partitioning, and the firſt for Tiling only.

Again, Laths are diſtinguiſh'd into 3 Kinds more, in Reſpect to their Lengths, *viz.* into 5 foot, 4 foot, and 3 foot Laths; tho' the Statute allows but of 2 Lengths, *viz.* thoſe of 5 foot and of 3 foot, each of which are to be an Inch and half in breadth, and half an Inch in thickneſs.

All theſe Sorts of Laths are neceſſary, (eſpecially in repairing of old Buildings) becauſe all Rafters are not ſpac'd alike, nor yet the Proportion ſtrictly obſerv'd in every one and the ſame Roof.

Bundle

Bundle of Laths.] A Bundle of Laths is so many as are bound up together, and is generally call'd a hundred of Laths; tho' of the 3 foot Laths there goes 7 Score or 140 to the hundred or Bundle, and of the 4 foot Laths, 6 Score, but of 5 foot Laths, there goes but just 5 Score to the hundred or Bundle.

The Size of Laths.] The Statute allows but of 2 Sorts of Laths, one of 5 foot, and the other of 4 foot in Length; of either Sort each Lath ought to be in Breadth an Inch and half, and in thickness, half an Inch; but they are commonly less, and are seldom exact, either in their Tales or Measures.

Of Cleaving Laths.] Lath-cleavers having cut their Timber into Lengths, they cleave each piece (with Wedges) into 8, 12 or 16 pieces (according to the largeness of their Timber) which they call *Bolts*; (with their Dowl-Ax) by the *Felt Grain* [which is that Grain which is seen to run round in Rings at the End of a Tree] into Sizes for the Breadth of their Laths, and this Work they call *Felting*.

Then lastly (with their Chit) they cleave their Laths into their thicknesses, by the *Quarter Grain*, which is that Grain which is seen to run in strait Lines towards the Pith.

Some say a Foot of Timber will make a Bundle of a hundred Laths; but this is not true, unless the Laths be made very slight: It has been found by many Experiments, that 40 Foot of Oaken round Timber will not make above 30 hundred, of which Number above 1 third part, *viz.* above 10 hundred will be Sap-Laths.

The Price of Laths.] The common price for cleaving of Laths, is 5*d* or 6*d per* Bundle, tho' some have said, they have had them made in *Sussex* for 4½ *d* the Bundle.

The Price of Laths must of Necessity be various, there being so great a Disparity in them; not only as to their Goodness, but likewise as to their Plenty and Scarcity. But the Prices are generally between 1*s.* and 2*s.* 6*d.* a Bundle: And the common Rate for *Heart Laths* is about 20*d.* and *Sap Laths* ⅔ of their Price.

Laths are sometimes sold for 4 *l.* 10*s.* the Carriage of 60 Bundles, 40 of which have been *Heart Laths*, and 20 *Sap Laths*, at which Rate (reckoning *Sap-Laths* to be ⅔ of the Price of *Heart Laths*) the *Heart Laths* were sold for 20 ¼ *per* Bundle, and the *Sap Laths* at 13½ *d.*

The Nails allow'd to a Bundle of Laths.] The common allowance is 5 hundred (at 6 Score to the hundred, which is 600) Nails to a Bundle of Laths.

How many Laths to a Square.] Workmen commonly allow a Bundle of Laths to a Square of Tiling, which (if the Distances of the Rafters fit the Lengths of the Laths without any waste) is a sufficient Allowance; for then about 90, five foot, and 112, four foot Laths will compleat a Square of Tiling. Counter Laths, and all at

at 7 Inches Gage, and at 8 Inches Gage, a Square, will not require so many.

LATHING. The Price of Lathing, Plaistering, rendring and washing with Size, is about 10*d.* 12*d.* or 14*d.* the Yard, for Materials and Work.

LATION, is the Translation or Motion of a Body from one Place to another in a right Line.

LATUS RECTUM [in *Conicks*] the same as Parameter.

LAZARETTO } a pub-
LAZAR-HOUSE } lick Building in Form of an Hospital for the Reception of poor sick Persons. It is usually a large Building at a Distance from any City, whose Apartments stand at a Distance from each other. In some Countries they are appointed for Persons who come from Places suspected of the Plague to Quarantain in; and where Ships are unladen and their Equipage is laid up for 40 Days, more or less, according to the Time and Place of Departure.

LEAD is a coarse, heavy, and impure Metal, of all others the softest and most fusible, when refin'd; those who have analys'd it, find it contains a little Mercury, some Sulphur, and a great Deal of Bituminous Earth.

Lead is found in various Countries, but most plentifully in *England*. It is likewise found in several Kinds of Soils and Stones, some of which contain besides Gold, some Silver and others Tin. &c.

It is melted in a Furnace provided for that Purpose, with a strong Coal Fire upon it. As it melts, it runs through a Canal on one Side of it, leaving the Earth, Stone and Scoria with the Ashes of the Coals.

It is purified by Skimming it before it is cold, and by throwing Suet and other fat Bodies into it: Some able Naturalists have observ'd, that Lead increases in Weight, either in the open Air, or under Ground.

Mr. *Boyle* observes this particularly of the Lead of Churches, which, he says, grows frequently both in Bulk and Weight, so as to become too ponderous for the Timber that before sustain'd it; which some account for from the Impurity, Hetero-Geneity, and loose Texture of its Parts, by means of which the Particles of the Air getting Admission within its Pores, are attracted and easily assimilated to it.

But others who rely wholly on Experience, absolutely deny the Effect, as also that it is reproduc'd in Mines before exhausted, by letting them lie long open to the Air, which others assert.

Lead is found of a lighter or deeper Colour, accordingly as it is more or less purified, tho' some make a Difference in the Colour of the Ore, always esteeming that most which is the whitest.

Lead is much us'd in Building, especially for Coverings, Gutters, Pipes and Glazing.

Lead is either cast into Sheets in a Mold, or mill'd, which last is found by much the

the leaſt ſerviceable, not only on Account of its thinneſs; but alſo becauſe 'tis ſo exceedingly ſtretch'd in milling, that when it comes to lie in the hot Sun, it ſhrinks and cracks, and of Conſequence will not keep out the Water.

The *Lead* us'd by *Glaſiers* is firſt caſt into ſlender Rods, 12 or 14 Inches long, call'd *Canes*, which being afterwards drawn thro' their Vice, comes to have a Groove on either Side for the Panes of Glaſs, and this they call *turn'd Lead.*

There are 3 Sorts of *Lead*, white, black, and aſh-colour'd, the white is more perfect and precious than the black, and the Aſh colour between both.

Of caſting Sheet Lead.] To do this, there is a Mould provided, which is ſomething longer than the Sheets are intended to be, that the End where the Metal runs off from the Mould may be cut off, becauſe 'tis commonly thin and uneven, or ragged at the End.

This Mould which is the exact Breadth that the Sheets are to be, muſt ſtand very even or level in Breadth, and ſomething falling from the End where the Metal is pour'd in, *viz.* about an Inch or Inch and half in the Length of 16 or 17 Feet.

This Mould uſually conſiſts of ſeveral Treſſels, upon which Boards are laid and nail'd down faſt, and upon theſe at a due Diſtance (according to the intended Breadth of the Sheets) the Sharps are fix'd.

Theſe Sharps are 2 Pieces of well ſeaſon'd Timber, of about 4 Inches Square, and 16, 17 or 18 Foot in Length, according to the Size of the Sheets.

But ſome having found an inconveniency in this Method of fixing down the Shafts, they only fix one of the Sharps firmly, nailing the other on but ſlightly, and then they fix ſeveral Pieces firmly to the Boards, without the ſlightly fix'd Sharps, betwixt which and the Sharp they drive Wedges, to make the Sharps come nearer together, as they ſee Occaſion; they having found by Experience, that the moiſtened Sand (when it has lain a while on the Boards) makes the Boards ſwell ſo much, that notwithſtanding the Nails, the Sharps will be too far aſunder.

At the upper End of the Mould ſtands the *Pan*, which is a Concave Triangular *Priſm*, compos'd of 2 Planks nail'd together at right Angles to each other, and 2 triangular Pieces fitted in betwixt them at the Ends.

The Length of this *Pan* is the whole Breadth of the Mould in which the Sheets are caſt, and the Breadth of the Planks of which 'tis compos'd, may be about 12 or 14 Inches, or more, according to the Quantity of Lead they have Occaſion to put into it to make a Sheet of, and the thickneſs of the Planks an Inch and a half.

This *Pan* ſtands with its Bottom (which is a ſharp Edge) on a Form at the End of the Mould, leaning with one Side againſt

against it, and on the opposite Side is a Handle to lift it up by, to pour out the melted Lead; and on that Side of the Pan next the Mould, are 2 Iron Hooks to take hold of the Mould, and prevent the Pan from slipping, when they pour the melted Lead out of it into the Mould.

This *Pan* is lin'd on the Inside with moisten'd Sand, to prevent it from being fired by the hot Metal.

The Mould is also fill'd up (from the upper End towards the lower End about $\frac{2}{3}$ parts of the Way with Sand sifted and moistened, after which a Man gets upon it, and treads it all over, with his Shoes on, to make it settle close to the Mould.

This being done, they begin to strike it Level with the *Strike*, which is a Piece of Board about 5 Inches broad, in the middle of which and towards the upper Edge is a wooden Pin (about 5 or 6 Inches long, and 1 or 1 $\frac{1}{4}$ Diameter) to hold it by when they use it.

The Length of this Strike is something more than the Breadth of the Mould on the Inside, and at each End is cut a Notch on the under Edge, about 2 Inches deep; so that when the Strike is us'd, it rides upon the Sharps with those Notches, and the lower Edge of the *Strike* rides about 2 Inches below the upper Side of the Sharps.

Then in levelling the Sand with the *Strike*, they begin towards the lower End of that Part of the Mould that was fill'd, and taking the Handle of the Strike in their right Hand, and laying the left Hand upon one End of it, they draw the Sand back into that Part of the Mould that was empty.

Then they begin again a little nearer to the upper End, and draw the Sand back (as before) but not so far as the empty Part of the Mould; so that when it is thus levell'd the whole Length of the Mould, there are as many Places which seem to be unlevell'd as there are levell'd, by Reason of the Sand which is a little drawn back.

The next Operation is to draw all the loose and Hover Sand (rais'd in the last levelling) into the empty Part of the Mould; to do which they begin at the upper End of the Mould, and still as the Sand is drawn back, the levell'd Part must be examin'd to see that there be no Cavities in it; which if there be, a little Sand must be put into them, and that must be settled close and fast in the Cavities, by lifting up one End of the Strike (letting the other rest upon the other Sharp) and rapping upon the loose Sand which was put into the Cavities, and this will settle it close and fast.

When this has been done all over the upper $\frac{2}{3}$ Parts of the Mould, and all the loose Sand has been drawn back into the lower $\frac{1}{3}$ Part of the Mould, that is also trampled and settled all

all over, and levell'd in all Respects as the other $\frac{2}{3}$ were, and its loose Sand is drawn off the Mould down into a Place 2 or 3 Inches below the lower End of the Mould, where the Sand is made into 2 Cavities to receive the overplus of the Lead.

The Sand being thus levell'd, the next Thing to be done is to smooth it all over with a *smoothing Plane* (as they call it) which is a thick Plate of polish'd Brass, about 9 Inches Square, a little turn'd up on all the 4 Edges, so that the Underside looks somewhat like a Diamond cut Looking-Glass, on the upper Side, (which is a little Concave, like a Latten Pan) is a brass Handle solder'd on, upon which is a wooden one also, like a Case-smoothing Iron.

With this Instrument they smooth the Sand all over, putting a little Sand in, where there are any small Cavities.

The Sand being thus smoothed, the Strike is made ready by tacking (that is by slightly nailing) on 2 Pieces of an old Felt-Hat on the Notches (or else by slipping a Case of Leather at each End) in order to raise the under Side of the Strike about $\frac{1}{8}$ of an Inch, or something more above the Sand, according as they would have the Sheets to be in thickness, which will make a middle-siz'd Sheet of about 9 or 10 Pound *per* Foot.

But for Hips and Window Soils, and such Places where it does not lie flat, the Lead need not be above $\frac{1}{10}$ of an Inch thick; but sometimes Plat-Form Lead is near $\frac{1}{6}$ of an Inch thick.

Then they tallow the under Edge of the Strike, and lay it cross the Mould close by the *Pan*, to prevent the Drops of Lead from spattering into the Mould before it be ready to pour.

When the Lead is melted (and the Pan made ready by being lin'd with moistened Sand) it is lav'd into the Pan, in which when there is a sufficient Quantity for the present Purpose, they draw off the floating Part with a Piece of Board 2 or 3 Inches broad, or scum off the Mettle round about to the Edge of the Pan, and let it settle upon the Sand, which will by that Means prevent the Sand from falling out of the Pan into the Mould at the pouring out the Metal.

When the Metal has been thus prepar'd and cool enough (which is known by its beginning to stand with a Shell or Wall round about on the Sand) then 2 Men taking the Pan by the Handle, pour it into the Mould, while a third Man stands (facing them and his right Side to the Mould) ready with the Strike, as soon as they have done pouring in the Metal to put it on the Mould, and so draws off the Overplus of the Lead into the Hollows made to receive it, and then they immediately cut off with a Knife the ragged End, before it is cold.

When the Sheet is grown a little cool, they begin to roll it up from the upper End downwards

taken off, naturally inclines to return to its former State.

For a Proof of this they refer you to *Greenwich* Hoſpital, which was covered with mill'd Lead, which after it had been done not above 4 or 5 Years, rain'd in almoſt all over the Hoſpital; upon which Account the Maſter and Wardens of the Plumbers Company were ſent for to the Parliament, who ordered them to go and view this mill'd Lead Work at *Greenwich* Hoſpital, which they did, and at their Return to the Parliament, they all unanimouſly declar'd, that mill'd Lead was not fit to be us'd: Whereupon the Parliament had Thoughts of putting down the milling of Lead.

Pipes of Lead.] Some Plumbers give diſtinct Names to their Leaden Pipes, according to their Weight at a Yard long, *e. g.* they have *6 l.* *8 l.* *10 l.* *12 l.* *14 l.* and 20 and *28 l.* Pipes, ſo that a Pipe of *6 l.* to the Yard, they call a *6 l.* Pipe

Lead for Glazing.] Some Glaziers ſay, that they uſually allow 50 Pound of turn'd Lead to 100 Foot of Quarry Glaſs: They call it *turn'd Lead*, when the *Came* has paſs'd thro' the Vice, and is thereby made with a Grove on each Side, to go on upon the Glaſs.

The *turn'd Lead* for Quarries is uſually about $\frac{2}{10}$ (which is almoſt $\frac{3}{16}$) of an Inch Broad; and for large ſquare Glaſs, their *turn'd Lead* is $\frac{8}{16}$ or $\frac{1}{2}$ an Inch broad, and they have it of theſe different Sizes $\frac{4}{16}$, $\frac{5}{16}$, $\frac{6}{16}$, $\frac{7}{16}$ and $\frac{8}{16}$ of an Inch broad.

The largeſt Size is for the large Squares, that of $\frac{5}{16}$ for Quarters, and the $\frac{4}{16}$ for crochet Work (or Fret Work as it is called by ſome Glaziers) it being more pliable for that Uſe than broader Lead.

Glaziers can turn Lead of different Sizes in the ſame Vice, by changing their Cheeks for each Size, with another Pair of Spindles, whoſe Nuts almoſt meet or touch; they turn Lead for Tyers, which when it comes out of the Vice, is almoſt cut aſunder in two Thickneſſes, which they can eaſily rend aſunder.

Theſe *Tyers* are very tough; but they are commonly made too ſlight, and therefore, ſome caſt *Tyers* which are ſtouter, but not ſo tough, being more apt to Break in winding.

Of Soldering.] As to the Method of *Paleing* (as they call it) or Soldering on of imboſt Figures on leaden Work; as ſuppoſe, a Face or Head with a Baſs Relief were to be paled on a Ciſtern of a Pump for an Ornament to it.

To perform this, the Plate where it is to be pal'd on, is firſt ſcraped very clean, and alſo the Back-ſide of the Figure, that it may fit cloſe with a good Joint.

Then they place that Part of the Ciſtern (on which the Figure is to be fixed) horizontally, and ſtrew ſome powdered Roſin on the Place where the Joint is made, then a Chaffing-Diſh of Coals being ſet into the Ciſtern juſt under the Place where the Figure is to ſtand

ſtand, 'till the Roſin is chang'd reddiſh, and begins to riſe in Pimples or Bladders, they take a Piece of ſoft Solder (made of a longiſh Figure) and rub the End of it round their Finger, keeping at the ſame Time their Finger ſteady in the Place, ſo that it may work into the Joint. And when this is done, the Figure will be well pal'd on, and will be as firm as if it had been caſt on there.

But if the Ciſtern, *&c.* be ſo thin, as that there may be Reaſon to fear that it will be too hot, and apt to run or bend, and yield before the Figure (which is on the out-ſide of it) will be hot enough; you may then lay your Figure on the hot Coals, 'till it, and the place to receive it, are both in a good Temper for *Paling*, and then ſet the figure on its Place, and proceed to ſoldering of it as before.

In Soldering the Leads of Churches, they ſometimes manage it as follows, *viz.* When they ſolder the Sheets of Lead, which are fixed into the Wall on one Edge, and with the other Edge lap over the Ends of thoſe which are ſeam'd in the Platform, at every other Sheet, in the middle betwixt the Seams, they Solder the lapping Sheets down to the other thus -----: With one corner of the Scraper [which is an Inſtrument made of a Plate of Steel in the form of an equilateral Triangle, in the Middle of which is fixed an Iron Strig, on the End of which is fix'd a wooden Knob, or Handle; the Plate is flat on the Side next the Handle, but on the other Side the Edges are ground off with a Bezel like a Chizel, only very obtuſe.]

They firſt mark out (partly on the Edge of the Lapping Sheet and partly on the other) an oblong rectangular Figure, of about 5 or 6 Inches long, and 3 or 4 broad, then they ſcrape the Metal bright, having firſt (becauſe it was new Lead) green'd it (as they phraſe it) all round about; to prevent the Solder's taking any where but where it has been ſcrap'd.

This *Greening* is only rubbing it with ſome green Vegetable, it matters not what, as Cabbage-Leaves, or any green Thing they can get.

After it has been ſcraped, they rub it with Tallow, and having a red hot Iron ready, they take a Piece of Felt in the Right Hand, and a Piece of Solder in the Left, and holding it againſt the Iron 'till it drops on the cleanſed Place, and when there is enough of it melted they take a Linnen Clout in the Left Hand, and with it keep the Solder continually ſhoved upon the cleanſed Place, and at the ſame Time work it about with the Iron in the Right Hand, 'till it is pretty well incorporated with the Lead, and ſo make it up into a kind of ſwelling Form in Breadth, and then croſs the Breadth of it making it into a kind of Seams withe the Point of the Iron.

When this is done, they take Knife and Dreſſer to knock it with,

with, and so cut it strait on the Sides and Ends, and what was thus cut off by reason of the *Greening* easily peeled off.

The Price of Lead in Pigs, says Mr. *Leybourn* is uncertain, as from 10 to 20*s.* the Hundred Weight. Sometimes it it is 10, sometime 12 s. sometimes 14 s. *per* Hundred Weight. *&c.*

Mr. *Wing* says, a Fodder of Lead is 22 ½ C. Weight, but most Authors say, but 19 ½ C. Weight, which is worth from 9 to 12 l. which will cast 315 Foot of Sheet, at 8 l. *per* Foot.

The Price of Sheet Lead.] Mr. *Leybourn* says that in Exchange of Old Lead for Sheets new run, there is commonly allowed 3 s. in every Hundred Weight for Waste and Workmanship.

The Price of casting Sheet Lead, is commonly about 4 s. *per* Hundred, for casting Old Lead into Sheets; but if so, probably the Plumber (for this Price) makes good so many Hundred Weight of Sheet Lead as he received of Old Lead; since Mr. *Leybourn* says it is done for 3 s. *per* Hundred.

Mr. *Wing* says, that there is about 2 s. 6 d. (in every Hundred) loss in casting Old Lead into Sheets. He also says, That casting Old Lead into Sheets is worth 1 s. 6 d. *per* Hundred.

The Price of laying on Sheet Lead in Roofing, &c.] This, Mr. *Wing* says, is worth 15 or 16 s. *per* Hundred Weight, Lead and Workmanship. And Mr. *Leybourn* says, that, Covering with Lead is usually valued at 13, 14, or 15 s. *per* Yard Square (according to the Goodness of the Lead) or between 7 and 8 Pound the Square of 10 Feet, besides Solder.

The Price of Solder] This, Mr. *Leybourn* says, is 9 d. or 10*d. per* Pound, as it is allay'd with Lead and scalled: For Tin is 10*d.* 11*d.* or 12*d. per* pound neat.

The Price of Leaden Pipes. This is Various according to their different Bigness.

Some say, that for Pipes of half an Inch Diameter in the Bore, they have 1 s. 4 d. *per* Yard, ¾ of an Inch Pipe, 1 s. 10 d. for Inch Pipe, and 1 ¼ Inch Pipe, 2 s. or 2 s. 6 d. (these last being said to be cast both in a Mould, only the Inch Pipe has a less Bore). For Pipes of an Inch ½ bore, 3 s. 6 d. *per* Yard, and for 3 Inch Pipes, 5 s. or 5 s. 6 d. *per* Yard. *London* Plumbers rate their Pipes according to the Weight of a Yard in Length, their 10 Pound Pipes are 2 s. 2 d *per* Yard.

The Price of turn'd Lead for Glazing is also various, according to its Breadth; that of $\frac{7}{16}$ broad has been sold for 18 s. per Hundred, that of $1\frac{5}{10}$ broad for 17 s.

RED LEAD is the lightest of all Reds now in Use; it is a Sandy, harsh Colour, and will not easily grind very fine, altho much Labour be bestowed on it.

This Colour is made out of common

Common Lead; having been firſt reduced to a Litharge, and afterwards ground to Powder in a Mill, 'tis then put into a hot Furnace, made for that Purpoſe, where it is continually kept ſtiring with an Iron Rake, 'till it has attain'd a fine Pale-Red Colour; the whole Proceſs of making it may be ſeen in Mr. *Ray*'s Appendix to his Catalogue of hard *Engliſh* Words.

Note, That though this is a Sandy Colour, yet it bears a very good Body in Oil, and binds very faſt and firm, being alſo a quick Dryer.

WHITE LEAD is the Principal of all *Whites*, and owes its Original to the Common Lead uſed by Plumbers, of which it is made.

The manner of making it at *Venice*, where the greateſt Quantities of it are made, is as follows.

They take Sheet Lead, and having cut it into long and narrow Slips, they make it up into Rolls; but ſo that a ſmall Diſtance may remain between every ſpiral Revolution: Theſe Rolls are put into Earthen Pots, ſo order'd that the Lead may not ſink down above half Way, or ſome ſmall matter more in them; theſe Pots have each of them very ſharp Vinegar in the Bottom, ſo full as almoſt to touch the Lead. When the Vinegar and Lead have both been put into the Pot, it is cover'd up cloſe, and ſo left for a certain Time, in which Space the corroſive Fumes of the Vinegar will reduce the Superficies of the Lead into a white Calx, which they ſeparate by knocking it with a Hammer.

There are two Sorts of this ſold at the Colour Shops, the one call'd *Ceruſe*, which is the moſt pure and clean Part, and the other is call'd by the plain Name of *White Lead*.

Theſe Colours work with very much Eaſe, and will be ground as fine as even the Oil itſelf, in Compariſon, if Time and Pains enough be taken in the grinding of it: It lies very ſmooth, and binds very hard, on what Work ſoever it be laid on.

If any Kind of Timber or Stone Work be painted with it, to preſerve it from the Weather, it is beſt to work it in Linſeed-Oil, for that will bind it extreme hard, if it be laid ſtiff upon the Work; but if *White Lead* be us'd alone within Doors, it will then be beſt to mix it with drying Nut Oil; for Linſeed Oil, within Doors, will turn yellow, and ſpoil the Beauty of it; which Inconvenience Walnut Oil made to dry, prevents, for that makes it keep a conſtant whiteneſs.

LEDGERS, See *Putlogs*.

LEMMA [in *Geometry*] is a Term us'd chiefly by Mathematicians, and ſignifies a Propoſition, which ſerves previouſly to prepare the Way for the more eaſy Apprehenſion of a Demonſtration of ſome Theorem, or for the Conſtruction of ſome Problem.

LENS [in *Opticks* and *Dioptricks*] is any Glaſs that is not very thick, which either

collects the Rays of Light into a Point, in their Passage thro' it, or disperses them farther apart, according to the Laws of Refraction.

Lenses have various Figures; that is, they are terminated by various Circumstances, from whence they acquire various Names.

Some are Plane on one Side, and Convex on the other; others Convex on both Sides, which are both usually rank'd among the Convex *Lenses*, tho' in accurate Speaking, the former is call'd *Plano Convex*.

Some are Plane on one Side, and Concave on the other, and others are Concave on both Sides, which are usually call'd *Concave Lens*, tho' when distinguish'd, the former is call'd a *Plano Concave*.

Others are Concave on both Sides; others are Concave on one Side, and Convex on the other; which are call'd *Convexo Concave*, or *Concavo Convex Lenses*, according as the one or other Surface is more Curve, or a Portion of a lesser Sphere.

LEVEL, A Mathematical Instrument, serving to draw a Line parallel to the Horizon; to lay off Floors, the Courses of Masonry, *&c.* Horizontally, to measure the Difference of the Ascent or Descent between several Places, to convey Waters, drain Fens, *&c.*

Carpenters LEVEL consists of a long Ruler, in the middle whereof is fitted at Right Angles, another somewhat bigger, at the Top of which is fastened a Line; which when it hangs over a fiducial Line at Right Angles with the Base, shews that the said Base is horizontal.

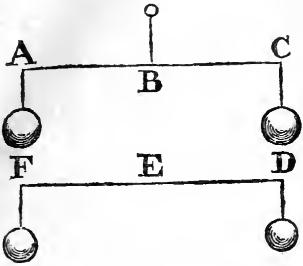
Masons LEVEL, is compos'd of 3 Rules, so join'd as to form an Isosceles Rectangle, somewhat like a Roman A; at the Vertex whereof is fastened a Thread, from which hangs a Plummet; which passes over a fiducial Line, marked in the middle of the Base, when the Thing to which the *Level* is apply'd, is horizontal; but declines from the Mark when the Thing is lower on one Side than the other.

LEVELLING, is the Art of finding a true Horizontal Line; or the Difference of Ascent or Descent between any 2 Places, or to determine the Height of one Place with Respect to another, for the laying of Grounds even, regulating of Descents, draining Morasses, conducting of Waters, *&c.*

The LEVER is no other than the *Ballance*, excepting the Manner of its Application in Practice.

LEVER [in *Mechanicks*] an inflexible Right Line, supported by a single Point on a *Fulcrum* or Prop, and us'd for the raising of Weights; being either void of Weight it self, or at least having such a Weight as may be balanc'd. The Lever is the first of those call'd *Mechanical Powers*; or *Simple Machines*, being of all others the most Simple, and is chiefly apply'd for raising of Weights to small Heights; that is,

is, as the Ballance is suspended or hung on the fixed Point or



Centre of Motion, as A C on B, the *Lever* rests upon a Point as D F on E, which is also call'd either the fix'd Point, *Centre of Motion*, *Fulcrum* or *Fulcimen*.

There are 4 Kinds of *Levers* in Use, call'd a *Lever* of the first Kind, a second Kind, a third Kind, and a fourth Kind.

A *Lever* of the first Kind is that whose *Fulcrum* is between the Power apply'd, and the Weight that is to be rais'd, as

A C, where the Power is apply'd at C, the Weight A, and the *Fulcrum* between them, as at B.

The Weight which may be rais'd by this *Lever* with a given or known Power or Strength apply'd at C, may be known by the following Canon or Analogy:

As the lesser Brachia A B, being always contain'd between the middle of the Lever, and the Weight to be rais'd, is to the greater Brachia B C,

So is the Power apply'd at C, to the Weight that it will raise at A.

Suppose the Lever A C to be 12 Foot long, and the Power apply'd, = 10 Pound Avoirdupoise, and let the Fulcrum B be at 9 Foot Distance from C.

Then I say,

As 3 the lesser Brachia,
Is to 9 the greater Brachia,
So is 10 the Power apply'd at C, to 30 the Weight that C will raise at A.

The *Operation.*

3 9 10 30
9
―――
3) 90 (30

And here observe, that the nearer the Fulcrum is plac'd to the Weight, the greater Weight can be rais'd,

As for Fxample,

Suppose the *Fulcrum* be plac'd at 10 Feet Distance from C at E, then I say,

As A E 2, the lesser Brachia,
is to E C 10 the greater Brachia,
So is 10 the Power, apply'd at C to 50, the Weight that C will raise at A.

The *Operation.*

2 10 10 50
10
―――
2) 100 (50

Now 'tis plain, that by moving the *Fulcrum* one Foot nearer towards the Weight, the Power is increas'd from 30 to 50, and therefore to Equipoise the Weight A on the *Fulcrum* E, then is but 6 Pounds requir'd, as a Power at C. For:

As E C 10 Feet the greater Brachia, is to A E 2 Feet.

So is 30 the Weight A, to 6 the Power requir'd at C, to equipoise A.

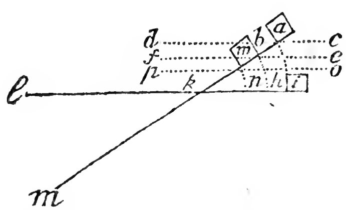
The *Operation.*

10	2	30	6
		2	
		10) 60 (6	

Hence it is evident that the nearer the *Fulcrum* is to the Body or Weight, the lesser Power it requires to equipoise the same, and consequently the lesser to raise the same; or otherwise the farther the Power is distant from the *Fulcrum*, the more Force it will proportionably have.

But here it is to be observ'd, that when by moving the *Fulcrim* near to the Weight by which the Power is increas'd, that at the same Time the Space or utmost Height of raising the Weight is diminished accordingly.

Let l L be *Lever* 12 Foot long, with its *Fulcrum* k, at 9



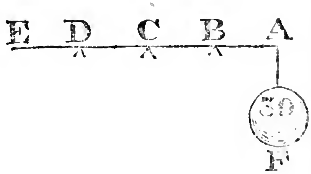
Feet from l; then if the Point l be depress'd to m, it will raise the Body i unto l, on the horizontal Line c d.

But if the Weight or Body i be mov'd nearer to k as at h, whereby a lesser Power will raise it, than when the End of the Lever l is depress'd, as before to m, the Body h will be rais'd no higher than b on the horizontal Line e f.

And again, had the Body i been plac'd at n, it could not be rais'd higher than m, on the Line o p, and so in like Manner of all others, Q E D.

Hence 'tis plain, that the higher the Body is rais'd, the greater Distance it must be from the *Fulcrum*, and consequently the greater Strength or Power is requir'd to raise the same.

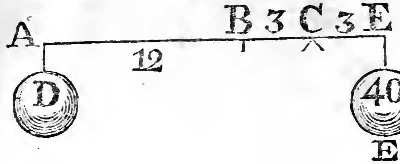
Whence it is evident, that as the Distance of the Weight from the *Fulcrum*, may be greater as B C, than the Distance



of the Power A B, or lesser (as A B) than the Power B C, or equal to one another, as A B, and B C in the Ballance, Figure 9; so proportionably must the Powers be apply'd.

Suppose that A E is a Lever 12 Foot long, that the *Fulcrum* be fix'd at C, 3 Feet from E, the Place where the Power is to be apply'd, and that the Body F hanging at E, weigh 30 Pounds; what Power at A will equipoise E, and by what Analogy is it to be found?

Answer.



Answer. The Analogy is as follows.

As C E 3, the lesser Brachia, is to C A 9, the greater Brachia,

So is 40 the Weight E, to 90 the Power required at E, to equipoise the Body F at A.

Operation.

3 9 40 120

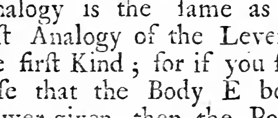
9

3)360(120

Hence 'tis plain, that this Analogy is the same as the first Analogy of the Lever of the first Kind; for if you suppose that the Body E be a Power given, then the Power requir'd to equipoise the same, is no more than to find the Weight or Power that the given Weight will equipoise.

This may suffice as to the Lever of the first Kind.

A LEVER of the Second Kind, is one wherein the first Point or *Fulcrum* is plac'd at



one End (as at A) the Power apply'd at the other End (as at C) and the Weight suspended between them, as at E B F, &c.

The following Canon or Analogy, will give the Weight that any given Power will raise, or what Power is requir'd to raise a given Weight; that is to say,

As the Distance of the Weight from the *Fulcrum*,

Is to the Distance of the Power from the *Fulcrum*,

So is the Power of the Weight that will equipoise it. And here note, that when the equipoise of any Weight is found, a very small Addition thereto is the Power that will raise it.

Let the Power at C be = 10 Pounds Averdupoise, and the Lever A C be = 12 Feet in Length, and let the Body D be hung in the Middle at B, 6 Feet Distant from the Power C, as well as from the *Fulcrum* A. Then I say,

As B C, 6 Feet Distance of the Weight from the Power, is to A B 12 Feet, the Distance of the Power from the *Fulcrum*, so is 10 Pounds the Power at C to 20 Pounds in *Æquilibrio*.

Again.

Let the Body D be mov'd to E, at 3 Feet Distance from the *Fulcrum* A. Then I say,

As A E 3, the Distance of the Weight from the *Fulcrum*,

Is to A C 12, the Distance of the Power from the *Fulcrum*,

So is 10 the Power apply'd at C, to 40 its *Æquilibrium*.

The *Operation*.

As 3 : 12 : 10 : 40
12

3) 120 (40

Again.

Let the Body or Weight D be mov'd to F, at 9 Feet Distance from the *Fulcrum* A;

Then I say,

As A F, 9 Feet the Distance of the Weight from the *Fulcrum*,

Is to A C, the 12 Feet, the Distance of the Power from the *Fulcrum*,

So is 10 the Power apply'd at C to 13 and a half its *Æquilibrium*.

The *Operation*.

9 : 12 : 10 : 13 + 3 qurs.
12

9) 120 (13 3 qurs.

Hence it is also evident, as in the *Lever* of the first Kind, that the nearer the Weight is to the *Fulcrum*, the greater is the Power increas'd.

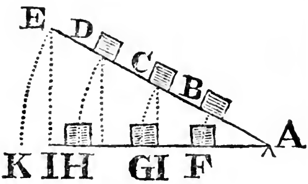
For in this last Example, where the Weight was apply'd at F, 9 Feet Distance from the *Fulcrum* A, the Power C 10 would equipoise but 10 Pounds 3 Quarters; but where the Weight was apply'd nearer to the *Fulcrum*, as at B, 6 Feet from the *Fulcrum* A; then its epuipoise was equal to 20 Pounds.

And again, when the Weight was apply'd still nearer to the *Fulcrum*, as at E, then the equipoise at C was = 40 Pounds, Q E D.

And as has been already prov'd in the Lever of the first Kind, that what is gain'd in Power, is lost in Space or Time; so also 'tis the same in this Kind of Lever.

For *Example*.

Suppose the Power at K, is to be rais'd from K to E, = 6 Feet above I, and at the same Time was to raise the Weight



G, plac'd in the middle of it; Then I say, that though the Weight equipois'd at C, is double to the Power E, yet G is rais'd but half the Height of E, above I; that is, as the equipoise G, rais'd to C, is double the Weight of the Power K, rais'd to E.

So is the Space or Arch E K through which the Power K pass'd in going to E, double or = twice the Space or Arch G C, through which the Body or Weight G pass'd in going to C, and so in like Proportion of all others, according to their Distance from the *Fulcrum*.

Now to find a Power equal to a given Weight, having the *Fulcrum* assign'd, and the Length of the Lever given.

This is the Analogy.

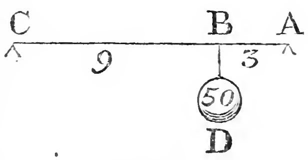
As the Distance of the Power from the *Fulcrum*,

Is to the Distance of the Weight from the *Fulcrum*, so is the given Weight to the Power requir'd to equipoise the same.

Let

Let the given Weight D, be = 50 Pound, plac'd at E, 3 Feet diſtant from the *Fulcrum* A, and let the Power be apply'd at C, 12 Feet diſtant from the *Fulcrum* A, then I ſay,

As 12 the Diſtance of the Power from the *Fulcrum*, is to A E 3, the Diſtance of the Weight from the *Fulcrum*, ſo is 50 the given Weight of the Body D to 12 and half the Power requir'd at C, to equipoiſe D.



Operation

As 12 3 50
3
———
12) 150 ($12\frac{1}{2}$
12
———
30
24
———
6
6
———
6 $12\frac{1}{2}$

Queſtion. When with a Lever of the Second, raiſes a Body of 50 Pound Weight, with a Power = to 25 Pound, what ſuſtains the other 25 Pounds?

Anſwer. The *Fulcrum* on which it reſts. For Proof,

Suppoſe that A and B were 2 Powers, ſuſtaining the Weight B at D, 3 Foot from A. As the Weight D is nearer to the Power at A, than to the Power at E, therefore the Power at A, ſuſtains the greater Part of the Weight.

Demonſtration.

I ſuppoſe A to be the only Power, and C the *Fulcrum* and let the Lever A C be = 12 Feet.

Then I ſay as before,

As A C 12, the Diſtance of Power A from the *Fulcrum* C,

Is to B C 9, the Diſtance of the Weight D from C.

So is D 50, the given Weight to 37 and a half, the Power requir'd at A to equipoiſe B.

Operation.

12 9 50 $37\frac{1}{2}$
9
———
12) 450 ($37\frac{1}{2}$
36
———
90
84
———
6 = $\frac{1}{2}$

Hence 'tis evident, that the Power A ſuſtains 37 and half Pounds of the Weight B, which is = 50 Pounds.

Again.

Suppoſe A to be the *Fulcrum*, and C the Power with the Weight as before.

Then I ſay.

As C A 12 the Diſtance of the Power C from the *Fulcrum* A,

Is to A B 3, the Diſtance of the Weight from the *Fulcrum*.

So is D 50, the given Weight to 12 and a half the Power requir'd to equipoiſe D.

 L E

The *Operation.*

12 3 50 $12\frac{1}{2}$

3

12) 150 ($12\frac{1}{2}$

12

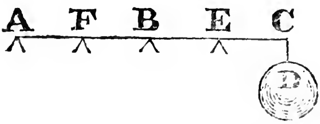
30

24

$6 = \frac{1}{2}$

Hence 'tis evident, that the Power C sustains but $12\frac{1}{2}$ Pounds. Now if to $37\frac{1}{2}$ be added $12\frac{1}{2}$, the Sum is $= 50$, the given Weight sustain'd by A and C. Q E D.

The LEVER of the third Kind hath its fix'd Point or



Fulcrum, at the other End, as D at G, and the Power apply'd at any Part between them, as E B F, &c.

Now seeing that the Power apply'd must be always between the 2 Ends; therefore it follows, that the Power must always exceed the Weight to be rais'd, or otherwise no Weight can be rais'd thereby.

Suppose the Lever A C $= 12$ Foot, A the *Fulcrum*, and at C is plac'd the Weight D $= 50$ Pounds. I say, that if the Power be apply'd in the middle at B, it must be $= 100$ Pounds Weight to equipoise D.

For the *Fulcrum* being fix'd at A, it makes a Resistance equal to the Weight D, or rather a greater; or otherwise the Power at B could not raise it. Therefore

As A B 6, the Distance of the Power from the *Fulcrum*,

Is to A C, 12 the Distance of the Weight from the *Fulcrum*,

So is 50 the given Weight D, to 100, the Power requir'd at B, to equipoise D at C.

Secondly. Suppose the Power to be apply'd at E, 3 Feet from the *Fulcrum* A;

Then I say,

As 3 Feet, the Distance of the Power from the *Fulcrum*,

Is to 12 Feet, the Distance of the Weight from the *Fulcrum*,

So is 50 the given Weight to 200, the Power requir'd at E, to equipoise D at C.

Again.

Suppose the Power to be apply'd at E, 9 Feet from the *Fulcrum* A;

Then I say,

As 9 Feet the Distance of the Power from the *Fulcrum*,

Is to 12 Feet the Distance of the Weight from the *Fulcrum*,

So is 50 the given Weight to 66 3 qrs, the Power requir'd at E, to equipoise D at C.

Now from these Examples 'tis also evident, that the farther the Power is apply'd from the *Fulcrum*, the lesser the Power is requir'd, tho' always greater than the Weight rais'd.

But however, tho' this Kind of Lever doth lose in its Power, contrary to both the others, yet it does not lose in Time or Space also, as they do; but on the contrary, it gains in Space or Time proportionably.

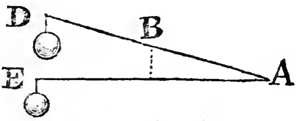
As for *Example.*

Let A E be a Lever $= 12$ Foot

Foot, A the *Fulcrum*, E the *Weight*; and the Power apply'd in the middle at C.

Then I say, if the Power C raises the Lever A E, with the Weight E into the Position A B D, then will E have pass'd the Arch E D, which is equal to twice the Arch B C, through which the Power C hath mov'd.

For since that A C is = A E; Therefore as A H is to H B, so is twice A h (that is A h + *h g*) to *g* D, which is =



to twice B *h* the Triangle A B *h*, and A D *g* being similar, Q E D.

This Kind of Lever is chiefly us'd in the Regulators of Water Engines, where it is required to strike a greater Stroke, than that of the Crank, as at *London Bridge*, where the Power of the Crank Rods are apply'd between the forcing Rods and the *Fulcrum* of the Regulator.

This Lever is also shewn by the raising of a Ladder, when the Power is apply'd in the middle; the End resting, or kept down on the Ground, as its *Fulcrum*, and the Weight beyond the Power, is the Weight requir'd to be rais'd.

Q. But suppose a Power is given with its Distance from the *Fulcrum*, as also the Length of the Lever, how is that Weight to be found, which the given Power can equipoise?

A. This is found by the following Canon or Analogy.

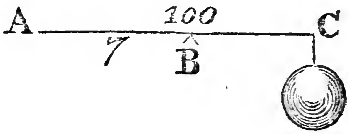
Suppose the given Power to be 100 Pounds, apply'd at 7 Feet Distance from the *Fulcrum*, and that the Length of the Lever is = 12 Foot.

Analogy.

As the Distance of the Weight from the *Fulcrum*,

Is to the Distance of the Power from the *Fulcrum*,

So is the Power apply'd to the Weight it will equipoise.



Then I say,

As 12 the Distance of the Weight from the *Fulcrum*, is to 7, the Distance of the Power from the *Fulcrum*,

So is 100 the Power apply'd at B, to 58 3 *qrs.* the Weight at C, which it can equipoise.

The *Operation.*

12 7 100

7

12) 700 (58, 3 *qrs.*

60

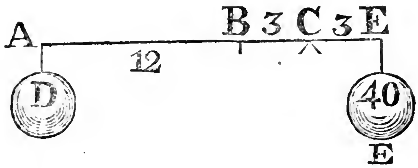
100

96

4 = 1 *qr.*

If a Lever of the third Kind, as C A, be continued beyond the *Fulcrum* = to the Distance of the Power apply'd (supposing B, the Power given) that is

is making E C = to C B, then it will become a Lever of the first Kind, and the same Power which was apply'd at B, as a Lever of the third Kind, being apply'd at E, as a Lever of the first Kind, will have the same Effect in equipoising the Body D, as when at B.



Suppose C A = 12 Feet, C B = 3 Feet, and let the Weight D sustain'd at A be equal to 10 Pound: Then I say, that if A C be continued to E, making E C = C B 3 Feet, then the same Power requir'd to equipoise D at B, being apply'd at E, will equipoise D also.

Demonstration.

First, considering E A as a Lever of the first Kind, whose *Fulcrum* is C, and let the Weight D be = 10 Pounds.

Then I say,

As E C 3, is to C A 12 : : So is D 10, to E 40, which is the equipoise of D, apply'd at E.

Again.

Considering C A as a Lever of the third Kind, with the Power apply'd at B, 3 Feet from the *Fulcrum* C.

As C A 12 is to C B 3 : : So is 40 apply'd at B to 10 its Equipoise at A.

Or as C B 3, is to C A 12; so is 10 the Weight at A, to 40 the Power apyly'd at B. Hence it is plain, that the same Power has the same Effect, either at E or B. Q E D.

These are the only distinct Kinds of Levers that are yet known; the fourth Lever being no more than the Lever of the first Kind, bended or making an Angle at its *Fulcrum*; as the Handle of a Hammer, considered with its Head and Claws, when us'd in drawing a Nail, for then its Head is the *Fulcrum*, and it being between the Claws that lay hold of the Nails and that Part of the Handle, where the Hand or Power is apply'd to draw the Nail, does therefore become a real Lever of the first Kind.

And tho' 'tis call'd a Lever of the fourth Kind, or the bended Lever, yet it is no more than a Lever of the first Kind, and the Analogies thereof are the same in all Respects.

N. B. That in the Practice of all these Operations, there has been no Allowance made for the real Weights of the Levers themselves, as has been noted; but therefore it must always be remembred in Practice, to make an Allowance for their own Weights, exclusive of the Powers apply'd.

LIGHTS [*in Architecture.*]

Are

Are underſtood of the openings of DoorsGates and Windows,and other Places through which the Air and Light have Paſſage.

LIME, calcin'd Stone, Marble, Free-Stone, Chalk, or other Matter, burnt in a large Fire in a Kiln or Furnace built for that Purpoſe; to be afterwards uſed in the Compoſition of Mortar for Building, the Fire taking away all its Humidity, and opening its Pores, ſo that it becomes eaſily reducible to Powder.

Mr. *Leybourn* tells us out of *Palladio*, That Stones, whereof Lime is made, are either dug out of Hills, or taken out of Rivers: That Lime is beſt, that is made out of the hardeſt, ſound, and white Stones, and being burnt, remains a third Part Lighter than the Stones whereof it is made.

All dug Stones are better to make Lime of than gathered Stones; and from a ſhady and moiſt Pit, than from a dry.

All Stones are ſooner or later Burnt, according to the Fire which is given them; but they are ordinarily burnt in Sixty Hours.

Sir *Henry Wootton* looks upon it as a great Error in the *Engliſh*, to make Lime as they do, of Refuſe and Stuff without any Choice, whereas the *Italians* at this very Day, and much more the Ancients, burnt their Firmeſt Stones, and even Fragments of Marble, where it was Plentiful, which in Time became almoſt Marble again, for its Hardneſs, as appears in their Standing Theatres, &c.

There are two Kinds of Lime in Common Uſe in *England*, the One made of Stone, and the other of Chalk, whereof the former is much the Strongeſt.

That which is made of ſoft Stone or Chalk, is the fitteſt for Plaiſtering of Ceilings, and Walls within Doors; and that made of hard Stone, is fit for Structures or Buildings, and Plaiſtering without Doors, that lie in the Weather.

And that which is made of a greaſy, clammy Stone, is ſtronger than that made of a poor lean Stone; and that which is made of a ſpungy Stone, is lighter than that made of a firm and cloſe Stone; that is again more Commodious for Plaiſtering, this for Building.

Good Lime may alſo be made of Mil-Stone, but not coarſe and ſandy, but fine and greaſy: as likewiſe of all Kinds of Flints; tho' 'tis hard to burn them, except in a Reverberatory Furnace as being apt to run to Glaſs, unleſs thoſe that are roll'd in Water, becauſe the greateſt Part of its Increaſe goes away by a Kind of Glaſs.

Dieuſſant recommends *Lime* made of Sea Shells, as Cockle, Oyſters, &c. as the beſt; but *Goldman* findes Fault with it, as being impatient of Moiſture, and therefore eaſily peeling off from the out-ſide Walls: However, it is the Common Lime uſed in the *Indies*.

About *Suſſex*, *Lime* is made of hard Chalk digged out of the Hills, and is burnt in Kilns

like Brick-Kilns, but with this Difference, that they have no Arches in them; but only a kind of Bench or Bank, on each Side, upon which they lay the largest Stones, and so truss them over and make an Arch, after the Manner of Clamps for Bricks, and when they have thus made an Arch with the largest Stones, they fill up the Kiln with the smaller ones.

Some have said that *Kentish Lime* is far better than that commonly made in *Sussex*; because they say, a Gallon of Water will make as much more *Kentish* Lime run, as it will of *Sussex* Lime; so that it should seem (by the Consequence) that, that is the best *Lime* which will run with the least Moisture.

Before the Stones are thrown into the Kiln, they are to be broken to Pieces; otherwise the Air contained in their Cavities, too much expanded by Heat, makes them fly with so much Violence as to damage the Kilns.

Alberti and *Palladio* say, that Lime will not be sufficiently burnt in less than Sixty Hours; and *Alberti* gives the Marks of a well burnt Lime to be as follows, *viz.* that its Weight is to that of the Stone in a sesquialterate Proportion; that it is white, light and sonorous; that when slaked, it sticks to the Sides of the Vessel. To which *Boeckler* adds, that when slaked, it sends forth a copious thick Smoak; and *Dieussant*, that it requires a great deal of Water to slake it.

Walter Burrel of *Cuckfield* in *Sussex*, Esq; was the First that introduc'd the Use of *Fern*, for burning of Lime, which serves that Purpose as well as Wood, (the Flame thereof being very vehement) and is far cheaper.

In order to preserve Lime several Years, slake and work it up; dig a Pit under Ground, into which let it pass through a Hole open at the Bottom of the Vessel: As soon as the Pit is full, cover it up with Sand, to prevent its drying; thus keeping it moist 'till it be used.

Boeckler gives another Method. Cover a Stratum or Layer of Lime Two or Three Foot high with another of Sand of the like height; pour on Water enough to slake the Lime, but not to reduce it to Dust after slaking. If the Sand cleave into clush as the Smoak ascends, cover them up, so as no Vent may be given thereto.

He says, that this Lime, being kept 10 or 12 Years, will be like Glue, and will further be of particular use in painting Walls, as being no way prejudicial to the colours.

Quick LIME, or unslak'd Lime, is that which is as it comes out of the Furnace.

Slak'd LIME, is that wash'd or steep'd in Water, and reserv'd for the making of Mortar.

Lime is commonly sold about *London* by the Hundred, which is 25 Bushels, or 100 Pecks; but in the Country, by the Load, of 32 Bushels.

A Load of Lime, as some say,

ſay, will make Mortar enough for 250 ſolid foot of Stone-work; and 8 Buſhels of Lime, heap'd Meaſure, is the common Allowance to every thouſand of Bricks.

The Price.] The Price of Lime differs according to the Places, as from 8 to 12 *s.* the Hundred.

Before the late Wars, which have made Fuel ſcarce (ſays a certain Author) *Lime* in ſome Parts of *Suſſex* has been ſold for 20 or 21 *s. per* Load, 32 Buſhels to the Load, but ſince, in ſome Parts of *Suſſex*, it has been ſold for 24 or 25 *s. per* Load, and in others for 32 *s.*

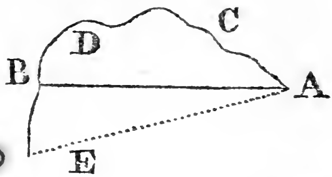
Yet in ſome Parts of *Suſſex* it is ſtill ſold for 12 *s. per* Load at the Kiln, and for about 15 *s.* 6 *d.* laid in 3 or 4 Miles.

LIME-STONE, is a Stone of a whitiſh Colour, which being burnt in a Kiln, enters the Compoſition of Mortar, Plaiſter, *&c.*

LIMITED Problem, is one which has but one, or a determined Number of Solutions; as to make a Circle paſs thro' 3 Points given, not lying in a right Line; to deſcribe an equilateral Triangle on a Line given.

LINE, according to *Euclid*, is a Longitude without Latitude, or a Length without Breadth or Thickneſs.

A Line is generated by the

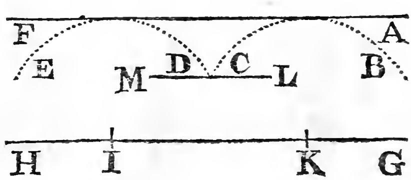


Motion of a Point from one Place to another. Thus the Point A moving directly from A to B, generates the right Line A B; therefore a right Line is the neareſt diſtance between two Points, which are the Bounds or Limits of it.

But had the Point A in going to B firſt gone to C, and thence to D, and afterwards to B, it would by its irregular Motion have deſcribed a crooked Line, as A C D B; which being irregular without any Reſpect to a Centre, is therefore call'd an irregular curv'd Line.

If the right Line A B be fix'd at the Point A as a Centre, and afterwards the End B be moved to E, it will by its Motion generate or trace the crooked Line B E; and becauſe that all the Parts of that crooked Line are at equal Diſtance from A, the Centre whereon it was deſcrib'd is therefore called a Regular curved Line.

A RIGHT LINE, G H being given to draw the Right Line A F, parallel at the given Diſtance of the Line L M,



First,

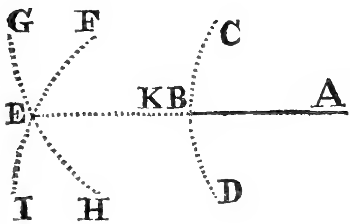
L I

First take the Length of your given Diſtance L M, in the Compaſſes, and with that Opening on any 2 Points, in the Ends of the Line G K, as at H I, deſcribe the Arches B C, and D E.

2. Lay a Ruler to the Extremes of thoſe Arches, and draw the Right Line A F, which will be parallel to G K, as requir'd.

The Right LINE A K of a certain Length being given to continue the ſaid Line A longer to E.

1ſt. On A with a opening of your Compaſſes, deſcribe an Arch, as C D; and from the

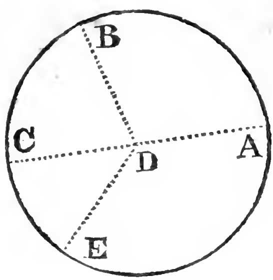


Point of Interſection, ſet off on the Arch any equal Diſtances to C and D.

2d. With any large Diſtances greater than D B, on the Points D and C deſcribe Arches, as F I and G H, interſecting each other in E.

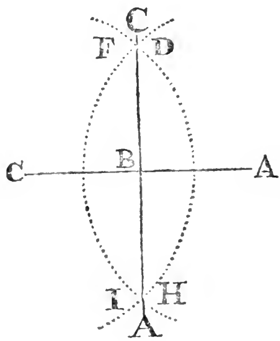
3d. From the Point B to the Point E, draw the Right Line B E the Continuation requir'd.

A Circular LINE is generated by the End of a Right Line. Suppoſe the Right Line A D, fix'd at its End D as a Centre, then if it be moved from A to B, and from B to C, its End A, will deſcribe a



Curv'd or Circular Line A B C, which is alſo call'd an Arch of a Circle; for was the Point C to be mov'd on to E, and from thence to A, it would compleat a round Space A B C E A, which is called a Circle.

To divide a Right Line A C into two equal Parts by the perpendicular A C.

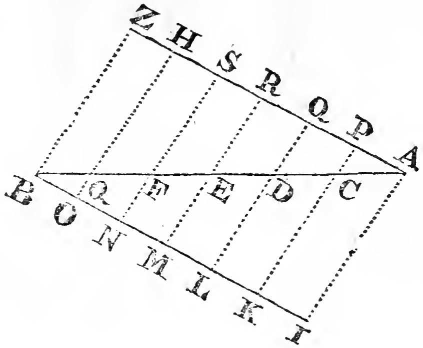


1ſt. Open the Compaſſes to any Diſtance greater than half the given Line A C, and at each End, as at A and C deſcribe Arches, as D B and F I, interſecting each other in the Points C and A.

2dly. From the Points A and C, draw the Right Line A C, which is the Perpendicular

cular requir'd, which will divide A C into two equal Parts, at the Point B.

To divide the Right LINE A B into any Number of equal Parts, as ſuppoſe 6.



1ſt. From one End of the given Line A B, draw another Right Line, as A B from A, making any Angle at Pleaſure; then from the other End, as B, draw the Right Line B I, parallel to it, or make the Angle A B I = to the Angle H A B.

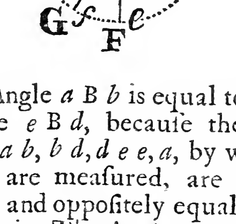
2dly. Open the Compaſſes to any Diſtance, ſuppoſe A P, and as the Line is to be divided into 6 Parts; therefore ſet off 5 of thoſe Diſtances on the Line A Z, at the Points P Q R S H, as likewiſe the ſame on the Line B I, at the Points O N M L K.

3dly. Draw the Lines P K Q L R M S N, and H O, and they will divide the Line A B into 6 equal Parts, at the Points C D E F G, as requir'd.

Theorem.

If any 2 Right LINES cut thro' one another, as A E cut by *b* F or *c* G, then are the oppoſite or vertical Angles equal to one another.

For *b* F cutting A E at right Angles, the Angle *a* B *b*, and *b* B *d* are equal, ſo alſo the Angle *b* B *d* is equal to the Angle *d* B *e*; and *d* B *e* to *e* B *a*; therefore they are all equal to one another, and therefore their oppoſite Angles are alſo equal; that is the Angle *b* B *d* is equal to the Angle *e* B *a*, and



the Angle *a* B *b* is equal to the Angle *e* B *d*, becauſe the Arches *a b*, *b d*, *d e e*, *a*, by which they are meaſured, are ſeverally and oppoſitely equal.

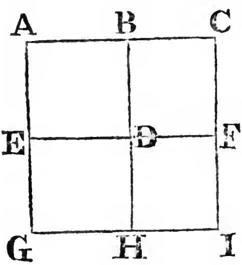
Again, The Angles *c* B *d* and *a* B *f* conſtituted by the Right Line *c* G, cutting A E in B are equal; becauſe the Arches *c d*, being of the ſame Radius with

with the Arch *f*, *a*, and equal thereto, are therefore equal to one another. So alſo are the oppoſite Angles *a* B *c*, and *f* B *d*; becauſe the Arch A C, is equal to the Arch *f d*. Q E D.

Theorem.

When a Right LINE *is divided into 2 equal Parts, the Squares made of thoſe Parts, are equal but to half the Square made by the whole Line.*

This is evident; for the 2 Squares A B E D and B C D. F, made by the Squares of

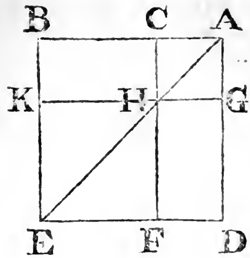


the 2 equal Parts of the Line AC, are equal but to half the Square, A C G I, made by the Square of the whole Line A C; becauſe that the other 2 Squares, D H F I, and E D G H, are equal unto them. Q E D.

Theorem.

When a Right LINE *is divided by Chance into 2 unequal Parts, the Square of the whole Line is equal to both the Squares made of the Parts; and to the 2 Parallelograms, comprehended under the ſame Parts alſo.*

That is, if the Right Line B A be accidentally divided in C, I ſay that the Square A B D E, is equal to the Squares



made of the Parts (A C G H, and H K F E) and the 2 Parallelograms C B H K, and G H D F alſo, whoſe oppoſite Sides are equal to the unequal Parts of the divided Line A B; becauſe that the whole is equal to all its Parts taken together; which being evident, needs no further Demonſtration.

Corollary.

Hence it appears, that the Parallelograms comprehended under the unequal Parts of the Line A B, *are equal to one another.*

For ſince that the Diagonal A H E doth divide the Square into two equal Parts, and thereby the Triangle A B E, is made equal to the Triangle A D E; ſo is alſo the Triangle A C H, equal to the Triangle A G E; and the Triangle H K E, to the Triangle H F E.

Now if from the 2 Triangles A B E and A D E you ſubtract or take away the equal Triangles A C H, A G H, H F E and H K E, the Remains will be equal; for if from equal Quantities you take away equal Quantities, the Quantities remaining will be equal.

Note, That the Squares A C G H and H K F E, are generally

rally call'd the Parallelograms, about the Diameter A E; but may be more properly call'd the Squares about the Diagonal A E; becauſe they are really Squares, and not Parallelograms; and the Line A E is a Diagonal common to them both, and not a Diameter, as it is call'd by *Euclid*, in his fourth Propoſition of his Second Book.

The Parallelograms C B H K, and G H D F, are call'd the Supplements or Complements of the two Squares A C G H, and H K F E, to the whole Square A B D E.

LINE *of Direction* [in *Mechanicks*] is that according to which a Body endeavours to move.

Horizontal LINE [in *Perſpective*] is the common Section of the Horizontal Plane, and that of the Draught or Repreſentation, and which paſſes through the principal Point.

Geometrical LINE [in *Perſpective*] is a Right-line drawn any how on the Geometrical Plane.

Terreſtrial LINE [in *Perſpective*] is a Right-line wherein the Geometrical Plane and that of the Picture or Draught interſect one another.

Terreſtrial LINE [in *Perſpective*] which is alſo called the *Baſe Line*, or *Line of the Plane*, is the Line that an Object is plac'd or ſtands upon, whereof each Object has its particular one, and the whole Draught a general one.

This is always parallel to the Horizon, and ſometimes ſerves to determine the Lengths and Breadths, particularly that at the Bottom of the Piece, whereto all the Meaſures are to be accommodated.

Objective LINE [in *Perſpective*] is the Line of an Object from whence the Appearance is ſought for in the Draught or Picture.

LINE *of the Front* [in *Perſpective*] is the common Section of the vertical Plane and of the Draught.

LINE *of Station* [in *Perſpective*] is, according to ſome Writers, the common Section of the vertical and geometrical Planes. Others mean by it the perpendicular Height of the Eye above the geometrical Plane: Others a Line on that Plane and Perpendicular to the Line expreſſing the Height of the Eye.

LINE *of Gravitation of any heavy Body* [in *Mechanicks*] is a Line drawn through its Centre of Gravity, and according to which it tends downwards.

LINE *of Direction of Motion of any Body*, is that according to which it moves, or which directs and determines its Motion.

LINEAR *Numbers* [in *Arithmetick*] are ſuch as have Relation to Length, as *v. gr.* ſuch as repreſent one Side of a plane Figure; and if the plane Figure be ſquare, the linear Number is called a *Root*.

LINEAR *Problem* [in *Mathematicks*] is ſuch an one as may be ſolved geometrically by the Interſection of two Right-lines; as to meaſure an inacceſſible

cessible Height, by means of two unequal Sticks: This is also call'd a Simple Problem, and is capable but of one Solution.

LINTEL [in *Architecture*] the Piece of the Timber that lies horizontally over Door Posts and Window Jambs, as well to bear the Thickness of the Wall over it, as to bind the Sides of the Walls together.

The Price.] Carpenters commonly put in these by the Foot running Measure, as *6 d. per* Foot, if Oak; and 4 *d.* if Fir, for Timber and workmanship.

LIST [in *Architecture*] is a little square Moulding, serving to crown or accompany a larger; or on occasion to separate the Flutings of a Column. It is sometimes called *Listella* and *Fillet*, and sometimes a *Square*.

LISTEL [in *Architecture*] a small Band, or a kind of Rule in the Mouldings; also the Space betwixt the Channellings of Pillars.

LOBBY. See *Antichamber*.

LOCAL PROBLEM [in *Mathematicks*] is such an one as is capable of an infinite Number of different Solutions; so that the Point which is to resolve the Problem, may be indifferently taken within a certain Extent. As suppose any where in such a Line, within such a plain Figure, &c. which is called *Geometrical Locus*, and the Problem is said to be a local or indeterminable one; and this local Problem may be either, *Simple*, when the Point sought is in a Right; *Plane*, when the Point sought is in the Circumference of a Circle; *Solid*, when the Point required is in the Circumference of a Conic Section; or lastly, *Sursolid*, when the Point is in the Perimeter of a Line of the higher Kind or second Gender, as Geometers call it.

LOCKS *for Doors* are of various Kinds; as for outer Doors, called Stock-locks; for Chamber-doors, call'd Spring-locks, &c. also the several Inventions in Locks, *i. e.* in contriving and making their Wards and Guards, are almost innumerable.

And as their Kinds are various, so are their Prices. I shall at present only mention some of the Chief, as

Stock Locks plain, from 10 *d.* to 14 *d. per* Piece, or more.

S Bitted Stock Locks, with a Pipe, 18 *d. per* Piece.

S Bitted and *warded Stock Locks* very strong, 7 *s.*

Brass Locks, from 5 *s.* 6 *d.* to 9 *s.*

Brass-knobbed Locks in iron Cases, 3 *s.*

Double Spring-Locks, 1 *s.*

Closet-door Locks, 1 *s.* 4 *d.*

Pad or Secret Locks, with Slits, instead of Pipes, 1 *s.*

Plate Stock Locks, 3 *s.* 8 *d.* Some ditto for half that Price.

Plate Stock Locks in Shute, 4 *s.* 6 *d.*

Brass-knobbed Locks in Shute, 6 *s.* 6 *d.*

Ironrimmed Locks, very large, 10 *s.*

Mr. *Chamberlain* in his *Present State of Britain*, tells us that there are some Locks made of

of Iron and Braſs of 50, nay 100 *l. per* Lock.

LOAM, a Sort of reddiſh Earth, uſed in Buildings (when tempered with Mud, Gelly, Straw, and Water) for plaiſtering Walls in ordinary Houſes.

LOGARITHMS, are Numbers in arithmetical Progreſſion, ſo fitted to the natural Numbers, that if any two natural Numbers are multiply'd and divided by one another, the Logarithms of theſe natural Numbers, that is, of thoſe anſwering them, be added to, or ſubtracted from each other, the Sum or Remainder will be the Logarithm of the Product, or the Quotient of thoſe two natural Numbers.

LONGIMETRY, the Art of meaſuring Lengths or Diſtances; or of taking the Diſtances of Trees, Steeples or Towers, *&c.* either one or many together.

LOGISTICAL *Arithmetick* was formerly the Arithmetick of Sexageſimal Fractions.

LUNES } [in *Geometry*]
LUNULÆ } are Spaces contained under a Quadrant of a Circle and a Semi-Circle; being called thus, becauſe they repreſent the Figure of the Moon, when leſs then half full.

LUTHERN, or *Dormer*, a kind of Window over the Cornice, in the Roof of a Building; ſtanding perpendicularly over the Naked of a Wall; and ſerving to illumine the upper Story.

The *French* Architects diſtinguiſh theſe into various Kinds, according to their various Forms; as *ſquare*, *ſemi-circular*, *Bulls Eyes*, *flat Arches Flemiſh Lutherns*, &c.

M.

MACHINE [in *Mechanicks*] an Engine; is whatſoever has Force ſufficient, either to raiſe or ſtop the Motion of a Body; or it may be defined any thing that ſerves to augment or regulate moving Powers; or it is any Body deſtin'd to produce Motion, ſo as to ſave either Time or Force.

Theſe Machines are either *ſimple*, or *compound*.

Simple Machines are commonly reckoned to be ſix in Number, *viz.* the *Ballance*, *Lever*, *Pully*, *Wheel*, *Wedge*, and *Screw*. To theſe might be added inclin'd Planes; ſince 'tis certain that the heavieſt Bodies may be lifted up by the Means thereof, which otherwiſe could ſcarce be moved.

Compound Machines, or Engines, are innumerable, in regard that they may be made out of the *Simple*, after almoſt infinite manners: And yet the Ancients ſeem to have outdone the Moderns in this reſpect; their Machines of Architecture, *&c.* being deſcrib'd as vaſtly ſuperior to ours.

A Machine for Building, is an Aſſemblage of Pieces of Wood, ſo diſpoſed as that by means of Ropes and Pullies a ſmall Number of Men may raiſe vaſt Loads or Weights, and lay them in their Places; as Cranes, *&c.*

'Tis hard to conceive what

Machines the Ancients must have used to raise these immense Stones found in some of the antique Buildings.

Hydraulick, or *Water* MACHINE, is either used to signify a *Simple Machine*, serving to conduct or raise Water; as a Sluice, Pump, *&c.* or several of these acting together, to produce some extraordinary Effect; as the Machine of *Marli* in *France*; the *Primum Mobile* or first Mover of which is an Arm of the River *Seine*, which by its Stream turns several large Wheels, which work the Handles, and these with Pistons raise the Waters up into the Pumps; and with other Pistons force it up in Pipes against the Ascent of an Hill to a Reservoir in a Stone Tower, 62 Fathoms higher than the River, sufficient to supply *Versailles* with a constant Stream, 200 Inches in Diameter.

MAGIC SQUARES, the several Numbers that compose any Square (as suppose 1, 2, 3, 4, 5, *&c.* to 25 inclusive, which compose the Square Number 25.) being dispos'd after each other in a square Figure of 25 Cells, each in its Cell. If then you change the Order of these Numbers, and dispose 'em in the Cells in such manner, as that the five Numbers which fill any horizontal Rank of Cells, being added together, shall make the same Sum with the five Numbers in any other Rank of Cells, whether horizontal or vertical; and even the same Number with the 5 in each of the two Diagonal Ranks; this Disposition of Numbers is called a *Magic Square*, in opposition to the former, which is called a *Natural Square*.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

16	14	8	2	25
3	22	20	11	9
15	16	4	23	17
24	18	12	10	1
7	5	21	19	13

Or a Magick Square is when Numbers in arithmetical Proportion are disposed into such Parallel and equal Ranks, as that the Sums of each Row, as well diagonally as laterally shall be equal: Thus,

These nine Numbers, 2, 3, 4, 5, 6, 7, 8, 9, and 10, being disposed into this square Form, they do every way directly and diagonally make the same Sum.

5	10	3
4	6	8
9	2	7

MAGNETISM, is the *magnetical Attraction*, or the Virtue and Power that the Magnet or Loadſtone has of drawing Iron to it.

MAGNITUDE, is the ſame as Bigneſs or Greatneſs. It is any thing that has Parts external, to Parts, connected together by ſome common Term; *i. e.* any thing locally extended or continued; or that has ſeveral Dimenſions.

The Origin of all Magnitude is a Point, which though void of Parts it ſelf, yet its Flux forms a Line; the Flux of that a Surface, and of that, a Body.

Literal MAGNITUDE, is a Magnitude expreſſed by Letters.

Numerical MAGNITUDE, is a Magnitude expreſſed by Numbers.

A Broken MAGNITUDE, is a Fraction.

A Complex MAGNITUDE, is that form'd by Multiplication.

An incommenſurable MAGNITUDE, is a Magnitude that has no Proportion to Unity.

MALLEABLE, ſomething hard and ductile, and that may be beaten, forged and extended under the Hammer.

All Metals are malleable, excepting Quickſilver; but Gold in the greateſt Degree of all.

MALLET, a kind of large Hammer, made of Wood, much uſed by Artificers who work with the Chiſſel; as Sculptors, Maſons, and Stone-cutters, whoſe Mallet is commonly round; Carpenters, Joiners, &c. who uſe a ſquare one.

MALTHA, a kind of Cement, anciently in great uſe, compoſed of Pitch, Wax, Plaiſter, and Greaſe.

Beſides this, the *Romans* had another kind of *Maltha*, with which they plaiſtered and whitened the Inſide of their Aqueducts. This was a very fine Cement, conſiſting of Lime ſlak'd in Wine, incorporated with melted Pitch and freſh Figs.

The *Natural* MALTHA is a kind of Bitumen with which the *Aſiaticks* plaiſter their Walls.

MANTLE [in *Architecture*] is the lower Part of the Chimney, or that Part laid acroſs the Jambs, and which ſuſtains the Compartiment of the Chimney Piece.

MARBLE, is a kind of Stone, extremely hard, firm, and ſolid, dug out of Pits or Quarries: It takes a beautiful Poliſh, cuts very hardly, and is much uſed in Ornaments of fine Buildings; as Columns, Altars, Statues, &c.

There is an infinite Number of different kinds of Marble, uſually denominated, either from their Colour, the Country where produced, or their Effects: Some are of one ſimple Colour; as *white*, or *black*; others ſtreak'd or variegated with Stains, Clouds, Waves, &c.

All *Marbles* are opake, except the white, which when cut into thin Slices, becomes tranſparent.

Marbles are alſo different in Weight and Hardneſs, and are to be conſidered with regard to their *Colour*, their *Country*, their *Grain*, and their *Defects*.

African Marble, is either of

a reddiſh Brown, ſtreak'd with Veins of *white*; or of a Carnation, with Veins of *green*.

Engliſh White Marble is vein'd with *Red*.

Marble of *Brabanzon* in *Hainault*, is black-vein'd with *White*.

Marble of *Auvergne* in *France* is of a pale *red*, mingled with *violet*, *green* and *yellow*.

Brocatelle Marble, is mingled with little Shades of *Iſabella*, *yellow*, *pale* and *gray*. This comes from *Tortoſa* in *Spain*, where it is dug out of an ancient Quarry.

There is alſo another ſort of *Brocatelle*, which is digged up near *Adrianople*.

Marble of *Champagne* reſembles the *Brocatelle*, being mix'd with *Blue*, in round Stains, like the Eyes of Partridges.

Marble of *Breſſe* in *Italy*, is yellow, with Spots of white.

Marble of *Carrara*, on the Coaſts of *Genoa*, is very white, and the fitteſt of all others for Works of Sculpture.

Cipollini or *Cipollin Marble*, is of a *Sea green* Colour, mix'd with large Waves or Clouds of *white*, or pale *green*.

Scamozzi thinks this is the ſame that the Ancients called *Auguſtum* and *Tiberium Marmor*, becauſe firſt found in *Egypt*, in the Times of *Auguſtus* and *Tiberius*.

Lumachello Marble, is ſo call'd becauſe mingled with Spots *grey*, *black*, and *white*, wreathed ſomewhat like Periwinkle Shells. This is ancient, and its Quarry is loſt.

Marble of *Margoſſe* in the *Milaneſe*, has a white Ground with *browniſh* Veins, reſembling the Colour of Iron ruſt. This is very common, and extremely hard.

Marble of *Dinan* near *Liege*, is of a pure black, very beautiful, and very common.

Marble of *Guachenet*, near *Dinan*, is of a reddiſh *brown*, with white Spots and Veins.

Marble of *Namure* is black, like that of *Dinan*, but leſs beautiful, as inclining a little to the *blue*, and traverſed with little Streaks of *grey*. This is very common, and is frequently uſed in Paving.

Marble of *Thou*, near *Namure* in *Liege*, is of a pure *black*, ſoft and eaſy to work, and receives a more beautiful Poliſh than thoſe of *Namure* and *Dinan*.

Marble of *Languedoc*, is of a vivid *red*, with large *white* Veins or Stains, and is very common. There is ſome whoſe *White* borders pretty much on the *blue*, and is leſs valued.

Marble of *Lavce* in *Maine*, has a black Ground, with little narrow Veins of *white*. There is another ſort of it *red*, with Veins of a dirty *white*.

Marble of *Ratrice* in *Hainault*, is of a dirty *red*, mix'd with *blue* and *white* Clouds and Veins. This is pretty common, but different in Beauty.

Marble of *Savcy* is of a deep *red*, mix'd with other Colours; each Piece of which ſeems cemented on to the reſt.

Parian Marble is antique, and much celebrated in Authors.

It

It is of a beautiful *white*: The greatest Part of the *Grecian* Statues were made of it. *Varro* calls it *Lychnites*, because the Workmen dug it out of the Quarry by Lamp light.

Marble of *Sicily*, is of a brownish *red*, stain'd with oblong Squares of *white* and *Isabella*, like strip'd *Taffetas*. The antient has very vivid Colours, and the modern comes pretty near it.

Marble of *Porta Santa*, at *Rome* called *Serna*, is mingled with large Clouds and Veins of *red*, *yellow*, and *grey*.

Marble of *Signan* in the *Pyreneans*, is ordinarily of a *greenish* brown, with red Stains, though this is somewhat various in its Colour.

Marble Portor has a *black* Ground, with Clouds and Veins of *yellow*. It is dug out of the Foot of the *Alps*, near *Carrara*.

Black Attic Marble, is of a pure *black*, without Stains, and softer than the modern black. There was some of it brought from *Greece*, called *Marmor Lucullеum*; but this was not so much valued as that which the *Egyptians* brought from *Ethiopia*, approaching to an iron Colour, and call'd *Basaltes*, or Touch-stone, because it serv'd them for the Trial of Metals.

Marble Bigio Nero, is antique.

Antient Black and *White Marble*, is now very rare, the Quarries of it being intirely lost. It is divided between a pure *white*, and a bright *black*, in Plates.

White-vein'd Marble, has large Veins with *grey*.

White Marble, dug out of the *Pyrenæans*, on the Side of *Bayonne*, is inferior to that of *Carrara*, its Grains being larger, and shining like a kind of Salt. It is something like the antient white *Greek* Marble, whereof their Statues were made, but not so hard and beautiful.

Marble Fior di Persica, comes from *Italy*, and consists of *red* and *white* Stains, somewhat *yellowish*.

White and Black Marble, has a pure *black* Ground, with some very white Veins.

Blue Tunquin Marble is mix'd with a dirty sort of *white*, and comes from the Coast of *Genoa*.

Yellow Marble is a kind of *Isabella* yellow without Veins; it is antique, and now very rare.

The *Modern Green Marble*, improperly call'd *Egyptian* Marble, is brought from *Carrara*, on the Coast of *Genoa*: It is a deep *green*, spotted with *grey*.

Green Marble Antique, is a Mixture of *Grass green* and *black*, in Clouds of unequal Forms and Sizes, and is very rare, the Quarries being lost.

Marble Occhio di Pavone, or Peacock's Eye, is mingled with *red*, *white*, and *blueish* Clouds, somewhat resembling the Eyes at the end of a Peacock's Tail.

Marble denominated from its Defects.

Rigid MARBLE, is that which being too hard, is wrought with

Difficulty, and is apt to ſplinter, as the *black* Marble of *Namure*.

Thready MARBLE, is full of Threads or Filaments.

Brittle MARBLE, is what crumbles under the Inſtrument; as the *White Greek Marble*, and that of the *Pyrenæans*, &c.

Terras MARBLE, is that which has ſoft Places in it, which muſt be filled up with Cement; as that of *Languedoc*.

There are two Defects frequent in *Marbles*, which make them the more difficult to be cut and poliſhed: The one is what Workmen ſometimes call *Nails*, which anſwers to the Knots in Wood: The other, call'd *Emeril*, is a Mixture of Copper, or other Metal, makeing *black* Stains in the Marble. The *Emerils* are only common to white Marbles; but the Knots to all.

Under the Genus of MARBLE is comprehended *Porphyry*, which is the hardeſt, and which was antiently brought from *Numidia* in *Africa*. The moſt beautiful is that whoſe *red* is the moſt vivid, and the Stains the whiteſt and the ſmalleſt. See *Porphyry*.

The *Serpentine* PORPHYRY, which is a *greeniſh brown*, ſo called, becauſe figured with little Stains. It is form'd of a great Number of Grains of Sand condenſed: It is of various Kinds, as *Egyptian*, *Italian*, *Violet*, and *Green*. See *Serpentine*.

Jaſper, of which there are various Kinds; the *Antient*, the *Florid*, the *Black*, the *White*, &c.

ALABASTER, of which there are various Kinds, both white and variegated.

They are all ſoft, when taken out of the Quarry, but harden in the Air.

Uſes.] The principal Uſes of Marble in Architecture is for Chimney-pieces, Chimney Foot-paces, Window-ſtools, Pavements, &c.

Pliny and other Authors tell us that the Antients uſed to face their Houſes all over with thin Plates of Marble.

Of poliſhing Marble.] Some lay three or four Blocks in a Row; and with another, fix'd to a broad Beetle, and a Handle fixed at oblique Angles, with Sand and Water between, work the upper Stone backwards and forwards on the lower ones, till the Strokes of the Ax are worn off; after which they poliſh them with Ivory and Putty.

Sometimes to poliſh Tomb Stones, they block up the Stones to be poliſh'd, ſo as to lie horizontal about 2½ Foot high above the Ground, and being laid very level, they work the upper Surface very ſmooth and even with a Tool for that Purpoſe.

This Tool is a Piece of whole Deal, about 18 or 20 Inches long, and 12 Inches broad, and croſs the Grain of the Wood on the upper Side are nail'd 2 Ledges on, at each End; and on theſe Ledges is nail'd a Staff or Handle, about 8 or 9 Foot long (enough to reach the Length of the Tomb-Stone) alſo at each End of the under Side

Side is nail'd a Ledge, and between thoſe Edges is wedg'd in (with wooden Wedges) a Hearth Stone of Marble, unpoliſh'd and very rough.

They fling Water and Sand upon the Tomb-Stone, and work it (by drawing the Hearth Stone to and fro) till the Hearth Stone becomes pretty ſmooth; then they take that out, and put in another rough Hearth Stone; and this they continue to do till they have wrought the Tomb-Stone pretty even and ſmooth.

But while the Tomb-Stone and Hearth Stones are rough, they lay a conſiderable weight (as a Stone or the like) upon the upper Side of the Tool, to keep it down hard on the Tomb-Stone; but when the Tomb-Stone is pretty ſmooth, they make it yet ſmoother, by putting into the Tool, one after another, ſeveral of thoſe Hearth Stones already begun to be poliſh'd, and this they continue to do, till they have brought both them and the Tomb-Stone to a more ſmooth poliſh. Upon theſe they uſe no weight on the back of the Tool, but they uſe Water and Sand as before; and if they have no Marble Hearth Stones to poliſh, they put a Purbeck Stone into the Tool.

The Price of Chimney Pieces] of black fleak'd Marble, or of Rance or Liver colour'd Marble, is worth, of an ordinary Size, 12 or 14 *l.* a Piece.

Window Stools of black or white fleak'd Marble, are worth about 2*s.* 6*d. per* Foot.

Pavements of black or white Marble is worth about 2 *s. per* Foot.

Engliſh white Marble vein'd with *Red*, &c. is ſold for about 2*s.* 6*d. per* Foot in Squares for Pavements, and Slabs of the ſame Sort of Marble (long enough for Chimney Foot paces) for 5*s. per* Foot.

Egyptian Marble vein'd with Variety of Greens in Slabs, 8*s. per* Foot.

Italian white Marble; for Chimney Foot Paces in Squares, for about 2*s.* 6*d. per* Foot; in Slabs, for 5*s. per* Foot, and black Marble is ſomething cheaper.

Of Staining Marble.] Father *Kircher* ſhews the Manner of applying Colours on Marble, ſo as to make them penetrate its whole Subſtance, inſomuch that if the Marble be ſlit into ſeveral parallel Tables or Planks, the ſame Image will be found on each, that was painted on the firſt.

Spots of Oil penetrate white Marble, ſo that they cannot be taken out.

The *Stuck* whereof they make Statutes, Buſts, Baſſo Relievo's, and other Ornaments of Architecture, is only Marble pulveriz'd, mix'd in a certain Proportion with Plaiſter; the whole well ſifted, work'd up with Water, and us'd like common Plaiſter.

There is alſo a Sort of artificial Marble made of *Gypſum*, or a tranſparent Stone reſembling Marble, which becomes very hard, receives a tolerable poliſh, and may deceive the Eye.

There is also a Sort of Marble form'd by corrosive Tinctures, which penetrating into white Marble to the Depth of a Line, imitates the various Colours of other Marbles.

Polish'd Marble is that which having been well rubb'd with Free-Stone, and afterwards with Pumice Stone, is at last polish'd with *Emery*, if the Marble be of several Colours; and if white, with Tin.

In *Italy* they polish with a Piece of Lead and Emery.

MARBLE COLOUR [in *Painting*.] That which is ordinary on new Stuff, is about 1 *s.* *per* Yard, and an old Colour about 9*d.* *per* Yard for Colour and Work.

MARQUETRY or *Inlaid Work*, is a Work compos'd of several fine hard Pieces of Wood of different Colours, fastened in thin Slices on a Ground, and sometimes inrich'd with other Matters, as Tortoise Shell, Ivory, Tin and Brass.

There is also another Kind of Marquetry made of Glasses of various Colours, instead of Wood; and also a third compos'd of nothing but precious Stones and the richest Marbles; but these last are rather call'd *Mosaic* Work.

The Art of Inlaying is very antient, and is suppos'd to have passed from *Asia* to *Europe*, as one of the Spoils brought from the Eastern Conquests by the *Romans* into *Italy*. It was indeed at that Time but a simple Thing, nor did it arrive at any tolerable Perfection before the fifteenth Century in *Italy*, nor did arrive at its Height till the 17th Century among the *French*.

The finest Works of this Kind were only black and white, which we now call *Moresco's*, till *John* of *Verona* Cotemporary with *Raphael*; but that Religious who had a Genius for Painting, stain'd his Woods with Dyes or boil'd Oils, which penetrated them.

But he went no farther than the Representations of Buildings and Perspectives, which require not any great Variety of Colours.

Those who came after him, not only improved on the Invention of dying the Woods, by a Secret they discovered of burning without consuming them, which serv'd exceedingly well for Shadows; but had also the Advantage of a Number of fine new Woods, of naturally bright Colours, by the Discovery of *America*.

With those Assistances the Art is now capable of imitating any Thing; whence it is by some call'd the *Art of Painting in Wood*.

The Ground on which the Pieces are to be arrang'd and glued, is usually of well dry'd Oak or Fir, and is compos'd of several Pieces glued together to prevent its warping.

The Wood to be us'd in Marquetry, is reduc'd into Leaves of the Thickness of a Line, *i. e.* the twelfth Part of an Inch is either stain'd with some Colour, or made black for Shadow; which some perform by putting it into Sand

ex-

extreamly heated over the Fire; others by steeping it in Lime Water, and Sublimate; and others in Oil of Sulphur.

Being thus colour'd, the Contours of the Pieces are form'd, according to the Parts of the Design they are to represent.

This last is the most difficult Part of Marquetry, and that which requires the most Patience and Attention.

The two chief Instruments us'd in this Work, are the Saw and the Vice; the latter to hold the Matters to be form'd, and the other to take off from its Extremes, as Occasion requires.

The Vice is of Wood, having one of its Chaps fix'd, the other moveable, and is open'd and shut by the Foot, by Means of a Cord fasten'd to a Treddle.

The Leaves to be form'd (for there are frequently 3 or 4, or more, of the same Kind, form'd together) are after they have been glued on the outermost Part of the Design, whose Profile they are to follow, put within the Chaps of the Vice; then the Workman pressing the Treddle, and thus holding fast the Piece with his Saw, runs over all the Out-Lines of the Design.

By thus joining or forming 3 or 4 Pieces together, not only Time is sav'd, but also the Matter is the better enabled to sustain the Effort of the Saw, which how delicate soever it may be, and how slightly soever the Workmen may conduct it, except this Precaution were taken, would be apt to raise Splinters, and ruin the Beauty of the Work.

When the Marquetry is to consist of one single Kind of Wood, or of Tortoise Shell on a Copper or Tin Ground, or *Vice versa*, they only form 2 Leaves, one on another, *i. e.* a Leaf of Metal, and a Leaf of Wood or Shell: This is call'd sawing in Counterparts; for by filling the Vacuities of one of the Leaves, by the Pieces coming out of the other, the Metal may serve as a Ground to the Wood, and the Wood to the Metal.

All the Pieces having been thus form'd by the Saw, and mark'd in Order to their being known again, and the Shadow given in the Manner before mentioned, each is vanneer'd or fasten'd in its Place on the common Ground, with the best *English* Glue.

This being done, the whole is set in a Press to dry, and planed over and polish'd with the Skin of the *Sea-Dog*, wax and shave grave, as in simple vaneering,

But withal with this Difference, that in Marquetry, the fine Branches, and several of the more delicate Parts of the Figures, are touch'd up and finish'd with a Graver.

Cabinet Makers, Joiners, *&c.* work in Marquetry; Stone-Cutters and Enamellers, deal in *Mosaic.*

MASON is a Person employed under the Direction of an Architect, in the raising of a Stone Building.

The chief Business of a Mason

ſon is to make the Mortar, raiſe the Walls from the Foundation to the Top, with the neceſſary Retreats and Perpendiculars to form the Vaults, and employ the Stones, as deliver'd to him.

When the Stones are large, the Buſineſs of hewing or cutting them, belongs to the Stone-Cutters, though theſe are frequently confounded with Maſons; the Ornaments of Sculpture, are perform'd by Carvers in Stone, or Sculptors.

The Tools or Implements principally us'd by them, are, the Square, Level, Plumb-Line, Revel, Compaſs, Hammer, Chiſſel, Mallet, Saw, Trowel, &c. Beſides the common Inſtruments us'd in the Hand, they have likewiſe Machines for raiſing of great Burdens, the conducting of large Stones, &c.

MASONRY is a Branch of *Architecture*, conſiſting, as it is defin'd by ſome, in the Art of hewing or ſquaring of Stones, and cutting them level and perpendicular for the Uſes of *Building*: tho' in a more limited Senſe of the Word, *Maſonry* is the Art of aſſembling and joining Stones together with Mortar.

Whence there ariſe as many different Kinds of Maſonry, as there are different Forms and Manners of laying or joining Stones.

Vitruvius mentions 7 Kinds of *Maſonry* among the Ancients. 3 of hewn Stone, *viz.* That in Form of a *Net*; that in binding, and that call'd the *Greek Maſonry*; and 3 of unhewn Stones, *viz.* that of an *equal Courſe*, that of an *unequal Courſe*; and that fill'd up in the middle; the ſeventh was a Compoſition of all the Reſt.

MASONS Work is ſometimes meaſured by the ſuperficial Foot, and ſometimes by the ſolid Foot; and in ſome Places Walling is meaſured by the Rood, which is 21 Feet in Length, and 3 in Height, which makes 63 ſquare Feet.

Example 1. If a Wall be 97 Feet 5 Inches in Length, and 18 Feet 3 Inches in Height, and 2 Feet 3 Inches thick, how many ſolid Feet are contain'd in that Wall?

```
F.      I.
97      5
18      3
--------------
776
97
  24 : 4 : 3
   6 : 0 : 0
   1 : 6 : 0
------------------
1777 : 10 : 3
   2 :    : 3
------------------
3555 :  8 : 6
 444 :  5 : 6 : 9
------------------
4000 :  2 : 0 : 9
```

```
    97.417
     18.25
----------
    487085
   194834
  779336
  97417
----------
1777.86025
      2.25
----------
 888930125
 355572050
355572050
----------
4000.1855625
```

The Length, Height and Thickneſs being multiply'd together, the laſt Product is 4000 Feet 2 Inches, the ſolid Foot contain'd in the Wall.

By Scale and Compaſſes.

Extend the Compaſſes from 1 to 1.825, and that Extent will reach from 97.417 to 1777.86; then extend them from 1 to 1777.86, and that Extent will reach from 2.25, to 4000, 18. the ſolid Content.

Example 2. If a Wall be 107 Feet, 9 Inches long, and 20 Feet 6 Inches high, how many ſuperficial Feet does it contain?

F.		I.		
107	:	9		
20	:	6		
2155	:	0		
53	:	10	:	6
2208	:	10	:	6

$$\begin{array}{r} 107.75 \\ 20.5 \\ \hline 53875 \\ 12550 \\ \hline 2208.875 \end{array}$$

Facit 2208 Feet, 10 Inches.

By Scale and Compaſs.

Extend the Compaſſes from 1, to 107.75, and that Extent will reach from 20.5 to 2208. 875. the ſuperficial Feet.

Example 3. If a Wall be 112 Feet 3 Inches in Length, and 16 Feet 6 Inches in Height, how many Roods does it contain.

F.		I.		
112	:	3		
16	:	6		
676	:	0		
112				
56	:	1	:	6
1852	:	1	:	6

$$\begin{array}{r} 112 \\ 16.5 \\ \hline 56125 \\ 67350 \\ 11225 \\ \hline 63)\ 1852.125\ (29 \\ 592 \\ \hline 25 \end{array}$$

Facit 29 Roods, 25 Feet.

By Scale and Compaſſes.

Extend the Compaſſes from 63 to 16.5, and that Extent will reach 112.25, to 29.460 Roods the Content.

Net Masonry, call'd *Reticulation*, from its Reſemblance to the Maſhes of a *Net*, conſiſts of Stones ſquar'd in their Courſes, and ſo diſpos'd, as that their Joints go obliquely, and the Diagonals are the one perpendicular, and the other level: This is the moſt agreeable Maſonry to the Eye, but it is apt to crack.

Bound Masonry, is that in which the Stones were plac'd one over another like Tiles; the Joints of their Beds being level,

Level, and the Mounters perpendicular: So that the Joint that mounts and ſeparates two Stones, fall directly over the middle of the Stone below. This is leſs beautiful than the *Net* Work, but is more ſolid and durable.

Greek MASONRY (according to *Vitruvius*) is that, where after 2 Stones have been laid, each of which makes a Courſe, another is laid at the End, which makes 2 Courſes, the ſame Order being obſerv'd throughout the Building, this may be called *Double Building*, in Regard that the binding is not only of Stones of the ſame Courſe with one another; but likewiſe of one Courſe with another Courſe

MASONRY *by equal Courſes*; this was by the Ancients call'd *Iſodomum*, and differs not from bound *Maſonry*; but only in this, that its Stones are not hewn.

MASONRY *by unequal Courſes*, which the Ancients call'd *Pſeudiſodomum*, was alſo made with unhewn Stones, and laid in *Bound Work*; but then they are not of the ſame Thickneſs, nor is there any Equality obſerv'd, excepting in the ſeveral Courſes; the Courſes themſelves being unequal to each other.

MASONRY *fill'd up in the middle*, which the Ancients call'd *Emplecton*, is likewiſe made of unhewn Stone, and by Courſes; but the Stones are only ſet in Order as to the Courſes; the Middle being fill'd up with Stones thrown in at Random among the Mortar.

Compound MASONRY, is of *Vitruvius*'s propoſing; and is ſo call'd, as being form'd of all the Reſt. In this the Courſes are of hewn Stone, and the middle Place left void, fill'd up with Mortar and Pebbles thrown in together. After which, the Stones of one Courſe, are bound to thoſe of another Courſe, with Cramp-Irons, faſten'd with melted Lead.

All the Kinds of MASONRY now in Uſe, may be reduc'd to theſe 5, *viz. Bound Maſonry*, that of *Brick-Work*, where the Bodies and Projectures of the Stones incloſe ſquare Spaces or Pannels, &c. ſet with Bricks: That *de Moilon*, or ſmall Work, where the Courſes are equal, well ſquared, and their Edges or Beds ruſticated; that where the Courſes are unequal; and that fill'd up in the middle with little Stones and Mortar.

MASQUE [in *Architecture*] is us'd of certain Pieces of Sculpture, repreſenting ſome hideous Form, Groteſque or Satyrs Faces, &c. us'd to fill up and adorn ſome vacant Places, as in Freezes, the Pannels of Doors, Keys of Arches, &c. but eſpecially in Grotto's.

MASTICOTE is a good, light yellow, for moſt Uſes, eſpecially in making Greens, of which there may be ſeveral Sorts made out of this Colour, by mixing it with Blues. This Colour grinds very fine, and bears a good Body.

MATHEMATICKS } MATHESIS } originally ſignify'd any Diſcipline or Learning; but now 'tis properly that Science

Science which teaches or contemplates, whatever is capable of being numbred or measured, as it is computable or measurable.

And the Part of Mathematicks, which relates to Number only, is call'd *Arithmetick*; that which relates to Measure in general, whether Length, Breadth, Motion, Force, *&c.* is call'd *Geometry*.

Mathematicks may be distinguished into *Simple* and *Mix'd*.

1. *Pure, Simple,* or *Abstracted*; which considers abstracted Quantity, without any Relation to Matter or sensible Objects; or

Mixt Mathematicks, which are interwoven every where with Physical Considerations; or it considers Quantity as subsisting in material Beings.

Mathematicks are also divided into *Speculative* and *Practical*.

1. *Speculative*, which proposes only the simple Knowledge of the Thing proposed, and the bare Contemplation of Truth, or Falshood. And

Practical, which teaches how to demonstrate some thing useful, or to perform something that shall be proposed for the the Benefit and Advantage of Mankind.

MEAN or *middle Proportion*, between any two Numbers or *Lines*, is that which hath the same Proportion.

Thus 6 is a Mean Proportional between 4 and 9, because 4 : 6 :: 6 : 9.

The Square of a Mean Proportional is equal to the Rectangle under the Extremes.

Two Mean Proportionals between two Extremes cannot be found by a strait Line and a Circle; but it may very easily be done by the Conick Sections, *&c.*

MEASURE [in *Geometry*] any certain Quantity assumed as one or Unity, to which the Ratio of other Homogeneous or Similar Quantities is expressed.

MEASURE *of a Number* [in *Arithmetick*] is such a Number as divides another without leaving any Fraction. Thus 9 is a Measure of 27.

MEASURE *of a Line*, is any right Line taken at Pleasure.

MEASURE *of a Figure*, or *plain Surface*, is a Square or Side of any determinate Length. Among Geometricians 'tis usually a *Perch*, called a *square Perch*, divided into 10 square Feet, and the square Feet into square Digits: Thence call'd *Square Measures*.

MEASURE *of a Solid*, is a Cube whose Sides are of any Length at Pleasure.

MEASURE *of an Angle*, is an Arch describ'd from the *Vertex* in any Place between its Legs.

MEASURE *of Velocity* [in *Mechanicks*] is the Space passed over by the moving Body in a given Time.

MEASURE *of the Mass or Quantity of Matter* [in *Mechanicks*] is its Weight.

MEASURING [*Geometrically* defin'd] is the assuming any certain Quantity, and expressing the Proportion of other similar

ſimilar Quantities to the ſame: But *popularly* defin'd, Meaſuring is the uſing a certain known Meaſure, and determining thereby the preciſe Extent, Quantity or Capacity of any Thing.

MEASURING [in the General] makes the practical Part of *Geometry*, from the various Subjects wherein it is employ'd: It acquires various Names, and conſtitutes various Arts.

MEASURING *of Lines* or Quantities of one Dimenſion is called *Longimetry*; and when thoſe Lines are not extended parallel to the Horizon, *Altimetry*; when the different Altitudes of the two Extremes of the Lines are alone regarded, it is called *Levelling*.

MEASURING *of Superficies* or *Quantities* of two Dimenſions, is denominated variouſly according to its Subjects. When it is converſant about Lands, it is called *Surveying*; in other Caſes, *ſimple Meaſuring*.

MEASURING *of Solids*, or Quantities of three Dimenſions, is called *Stereometry*; when it is converſant about the Capacities of Veſſels, or the Liquors they contain particularly, *Gauging*.

MECHANICKS, is the *Geometry* of Motion, being that Science which ſhews the Effect of Powers or moving Forces, ſo far as they are applied to Engines, and demonſtrates the Laws of Motion.

MECHANIC *Powers*, are the five ſimple Machines, to which all others, how complex ſoever, are reducible, and of the Aſſemblage thereof they are all compounded.

MECHANICAL *Affections of Matter*, are ſuch Properties of Matter as reſult from their Figure, Bulk, and Motion.

MECHANICAL *Solution of a Problem* [in *Mathematicks*] is either when the Thing is done by repeated Trials; or when the Lines made uſe of to ſolve it, are not truly Geometrical.

MEDIATE or *Intermediate*, is a Term of Relation to two Extremes, applied to a third, which is in the Middle.

MEMBRETTO [in *Architecture*] an *Italian* Term for a *Pilaſter*, that bears up an Arch: Theſe are often fluted, but not with more than ſeven or nine Channels. They are frequently uſed to adorn Door-Caſes, Gallery Fronts, and Chimney Pieces, and to bear up the Corniches and Freezes of Wainſcot.

MENSURABILITY, is an Aptitude in a Body whereby it may be applied or conformed to a certain Meaſure.

MENSURATION, or Meaſuring, is the Art or Act of finding the Superficial Area or ſolid Content of Surfaces or Bodies.

METOCHE [in *Antient Architecture*] is a Term uſed by *Vitruvius* to ſignify the Space or Interval between the Dentils.

METOPE } [in *Architecture*] is the Interval or ſquare Space between
METOPA } the Triglyphs of the Freeze of the *Doric*, which among the Antients us'd to adorn thoſe Parts with carved Work or Painting, repreſenting the Heads of Oxen, and other Utenſils of the heathen Sacrifices.

As

As there is found ſome Difficulty in diſpoſing the *Triglyphs* and *Metopes*, in that juſt Symmetry that the *Doric* Order requires, ſome Architects make it a Rule, never to uſe this Order, but in Temples.

METOPES. M. *le Clerc* ſays, the Beauty of them conſiſts in their Regularity, that is, in their being perfect Squares: And yet, when they are really ſquare, they appear to be leſs in Height than in Breadth; which is owing to the Projecture of the little Bandelet wherein they terminate underneath, which hides a ſmall Part of their Height: For which Reaſon he makes the *Metopes* a Minute or two more in Height than in Breadth; being of Opinion they ought rather to appear ſquare, without being ſo, than to be really ſo, without appearing ſo.

He alſo obſerves, that when the Triglyphs and Metopes follow each other regularly, the Columns muſt only ſtand one by one; exempting thoſe of the inner Angles, which ought always to be accompanied with two others, one on each Side; from which the reſt of the Columns may be placed at equal Diſtances from each other: And it is to be obſerv'd, that theſe two Columns, which accompany that of the Angle, are not leſs neceſſary on the account of the Solidity of the Building, than of the Regularity of the Intercolumniations.

Semi-METOPE, is a Space ſomewhat leſs than half a Metope in the Corner of the *Doric* Freeze. The Word Metope in the original *Greek* ſignifies the Diſtance between one Aperture or Hole and another; or between one Triglyph and another; the Triglyph being ſuppoſed to be Solives or Joiſts that fill the Apertures.

MEZZANINE, a Term us'd by ſome Architects, to ſignify an *Entreſole*.

The Word is borrowed from the *Italians*, who call thoſe little Windows which are leſs in Height than in Breadth, which ſerve to illuminate an Attic or an Entreſole, *Mezzanine*.

MILLION [in *Arithmetick*] the Number of ten hundred thouſand, or a thouſand thouſand.

MINUTE [in *Architecture*] is the 30th or 60th Part or Diviſion of a Module; as a Module is uſually the Diameter of the lower Part of a Column.

MITCHELS, are Purbeck Stones for paving, peck'd all of a Size, from 15 Inches ſquare to two Foot, being ſquar'd and hew'd ready for Paving. They are ſaid to be ſold at 2 *s.* 10 *d.* *per* Foot.

MIXT *Number* [in *Arithmetick*] is that which is partly an Integer, and partly a Fraction; as $6\frac{3}{4}$.

MIXT *Figure* [in *Geometry*] is that which conſiſts partly of right Lines, and partly of curved ones.

MODEL [in *Architecture*] is particularly uſed in Building for an artificial Pattern made in Wood, Stone, Plaiſter, or other Matter, with all its Parts and Proportions, in order for the better

better conducting and executing ſome great Work, and to give an Idea of the Effect it will have in large; or it may be defin'd a ſmall Pattern of a Houſe, &c. made by a ſmall Scale; wherein an Inch, or half an Inch repreſents a Foot, for the more exactly carrying on the Deſign.

In all large Buildings it is much the ſureſt way to make a *Model* on *Relievo*, and not to truſt to a bare Deſign or Draught.

MODERN [in *Architecture*] is improperly applied to the preſent, or *Italian* Manner of building; as being according to the Rules of the *Antique*; nor is the Term more properly applied, when attributed to Architecture purely *Gothic*.

Modern Architecture, ſtrictly ſpeaking, is only applicable to that which partakes partly of the antique, retaining ſomewhat of its Delicacy and Solidity, and partly of the *Gothic*; whence it borrows Members and Ornaments without any Proportion or Judgment.

MODILLIONS [in *Architecture*] are Ornaments in the Corniſh of the *Ionic*, *Corinthian*, and *Compoſite* Columns.

The *Modillions* are ſmall Conſoles or Brackets, under the Soffit or Bottom of the Drip of the Corniſh, ſeeming to ſupport the *Larmier*, tho' in Reality they are no more than Ornaments.

They ought always to be plac'd over the Middle of the Column. They are particularly affected in the *Corinthian* Order, where they are uſually inrich'd with Sculpture.

The *Modillion* is uſually in the Form of an S inverted, and fitted to the Soffit of the Corniſh.

The Proportion of *Modillions* ought to be ſo adjuſted as to produce a Regularity in the Parts of the Soffits.

The *Inter-Modillions*, i. e. the Diſtances between them, depend on the inner Columns, which oblige the *Modillions* to be made of a certain Length and Breadth, in order to make the Intervals perfect Squares, which are always found to have better Effect than Parallelograms.

Alſo in adjuſting the *Modillions*, Care is to be taken that they have ſuch a Proportion, as that when the Orders are plac'd over one another, there be the ſame Number in the upper Order as in the lower, and that they fall perpendicular over one another.

Modillions are alſo uſed under the Corniſhes of Pediments, tho' *Vitruvius* obſerves that they were not allowed of in his Time, becauſe *Modillions* were intended to repreſent the Ends of Rafters. *Daviler* rather takes them for a kind of inverted *Conſoles* or *Corbels*.

The *Modillions* are alſo ſometimes called *Mutules*; tho' Uſe has introduced a little Difference between the Idea of a *Modillion* and a *Mutule*; the *Mutule* being peculiar to the *Doric* Order; and the *Modillions* to the higher Orders.

In the *Ionic* and *Compoſite* Orders, *Modillions* are more ſimple, having ſeldom any Ornaments,

ments, except ſometimes a ſingle Leaf underneath.

M. *Le Clerc* obſerves on the *Corinthian* Order, that it is uſual to have a Leaf that takes up their whole Breadth, and almoſt their whole Length too.

But he is of Opinion, that the *Modillions* would be more graceful, if this Leaf were leſs both in Length and Breadth.

For this Reaſon he incloſes it between two Liſts, wherein it ſeems, as it were, to be ſet, and out of which it never comes, but to form its Return againſt the little Wave of the *Modillions*, which it joins without hiding: From this Relation of the Leaf with the *Modillions*, the latter is render'd exceeding graceful.

The Leaf of the *Modillion* ought to be of the ſame Kind with thoſe which make the Ornament of the Capital; which is a Rule not to be diſregarded.

He likewiſe obſerves, that in meaſuring of the *Modillions* of the *Roman*, and the other Orders, are not barely concerted with a View to the juſt Proportion of thoſe Parts, but alſo to eſtabliſh a Regularity in the Parts of the Plafond or Soffit of the Cornice.

The Diſtance between one *Modillion* and another, depends on that between the Intercolumns; and that Diſtance obliges us to make the *Modillions* of a certain Height and Breadth; in Order to have the Spaces that ſeparate them in the Soffit, perfectly ſquare.

Not only becauſe thoſe Squares are more regular than long Squares, but alſo becauſe they may be continued uniform through the projecting and re-entering Angles, which long Squares are incapable of; as may be obſerv'd in the Buildings, made according to the Rules of *Vignola*.

Further, in making the Diviſion of the Inter-Modillions, Care muſt be taken, that they have ſuch a Proportion, as that when the Orders are plac'd over one another, the *Modillions* of the lower Order be found in the ſame Number.

He alſo obſerves, as to the Intervals of the *Modillions* of the *Spaniſh* Order, that they are farther apart than in the *Roman*, but leſs than in the *Corinthian*, which is a Thing neceſſary, in Order to be able, on Occaſion, to place theſe Orders one over another.

For as any Order ought to be leſs high than that whereon it is plac'd; the *Corinthian* when plac'd over the *Spaniſh*, ſhould be leſs than the *Spaniſh*, as that when plac'd over the *Roman*, ſhould in like Manner be leſs than the *Roman*: So that the under Columns being bigger than the upper, the Bottom of the upper being bigger than the Top of the under, and yet their *Modillions* be found exactly over one another, which were Things impracticable, unleſs the *Modillions* were at the ſame Diſtance, proportional to the Orders.

Whence it may be obſerv'd, that it is not enough to compoſe beautiful Orders; but they muſt alſo be match'd and

adjusted to one another, if they are to go together, as 'tis frequently necessary they should do.

MODULE [in *Architecture*] is a certain Measure or Bigness taken at Pleasure, for regulating the Proportions of Columns, and the Symmetry or Distribution of the whole Building.

Architects generally chuse the Semi-Diameter of the Bottom of the Column for their *Module*, and this they subdivide into Parts or Minutes.

The *Module* of *Vignola*, which is a Semi-Diameter, is divided into 12 Parts in the *Tuscan* and *Doric*; and into 18, for the other Orders.

The *Module* of *Palladio*, *Scamozzi*, M. *Cambray*, *Desgodetz*, *Le Clerc*, &c. which is also equal to the Semi-Diameter, is divided into 30 Parts or Minutes in all the Orders.

The whole Height of the Column is divided by some into 20 Parts for the *Doric*, 22½ for the *Ionic*, 25 for the *Roman*, &c. and one of these Parts, is made a *Module*, to regulate the Rest of the Building by.

There are two Ways of determining the Measures or Proportions of Buildings.

The *First* is, by a fixt Standard Measure, which is usually the Diameter of the lower Part of the Column, call'd a *Module*, subdivided into 60 Parts, call'd Minutes.

In the *Second*, there are no Minutes, nor any certain or stated Division of the *Module*; but it is divided occasionally into as many Parts as are judg'd necessary.

Thus the Height of the *Attic* Base, which is half the *Module*, is divided into 3, to have the Height of the Plinth; or into 4 for that of the greater *Torus*, or into 6, for that of the lesser.

Both these Manners have been practised by the ancient, as well as the modern Architects; but the Second, which was that chiefly us'd among the Ancients, is in the Opinion of M. *Perrault*, the most preferable.

As *Vitruvius* has lessen'd his *Module* in the *Doric* Order, which is the Diameter of the lower Part of the other Orders, and has reduc'd that great *Module* to a mean one, which is the Semi-Diameter, the *Module* is here reduc'd to the third Part for the same Reason, *viz.* to determine the several Measures without a Fraction.

For in the *Doric* Order, besides that the Height of the the Base, as in the other Orders, is determin'd by one of these mean *Modules*; the same *Module* gives likewise the Heights of the *Capital*, *Architrave*, *Triglyphs*, and *Metopes*.

But our little *Module*, taken from the third of the Diameter of the lower Part of the Column, has Uses much more extensive; for by this, the Height of Pedestals, or Columns and Entablatures in all the Orders, are determined without a Fraction.

As then the great *Module* or Diame-

Diameter of the Column has 60 Minutes, and the mean *Module* or half the Diameter 30 Minutes, our little *Module* has 20.

MOMENT [in *Mechanicks*] is the ſame with Impetus or the Quantity of Motion in any moving Body; and ſometimes it is us'd ſimply for the Motion it ſelf. *Moment* is frequently defin'd by the *vis inſita*, or the Power by which moving Bodies continually change Place.

MOMENTS [in *Geometry*] are the generative Principles of Magnitude; they have no determin'd Magnitude of their own, but are only inceptive thereof.

MONOPTERE [in the ancient *Architecture*] a Kind of Temple, round and without Walls, having a Dome, ſupported with Columns.

MONUMENT [in *Architecture*] a Building deſtin'd to preſerve the Memory, &c. of the Perſon who rais'd it, or for whom it was rais'd. Such is a Triumphal Arch, a Mauſoleum, a Pyramid, &c.

The firſt Monuments that were erected by the Ancients, were the Stones which were laid over Tombs, on which were cut the Names and Actions of the Deceas'd.

Theſe Stones were diſtinguiſh'd by various Names, according as their Figures were different. The *Greeks* call'd thoſe which were ſquare in their Baſe, and were the ſame Depth throughout their whole Length, *Steles*; from whence our Square Pilaſters or *Attic* Columns were deriv'd.

Thoſe which were round in their Baſe, and ended in a Point at Top, they call'd *Styles*, which gave Occaſion to the Invention of diminiſh'd Columns.

Thoſe which were ſquare at the Foot, and terminated in a Point at the Top, in the Manner of a Funeral Pile, they call'd *Pyramids*.

To thoſe whoſe Baſes were more in Length than in Breadth, and which roſe ſtill leſſening to a very great Height, reſembling the Figure of the Spits or *Obelisks*, or Inſtruments which the Ancients us'd in roaſting their Sacrifices, they called *Obelisks*.

MONOTRIGLYPH [in *Architecture*] a Term that ſignifies the Space of one Triglyph between two Pilaſters or two Columns.

MORISCO WORK } a Kind
MORESK WORK } of antic Work in Carving or Painting, done after the Manner of the Moors, conſiſting of ſeveral Groteſque Pieces and Compartments, promiſcuouſly intermingled, not containing any perfect Figure of a Man or other Animal, but a wild Reſemblance of Birds, Beaſts, Trees, &c.

MORTAR } [in *Architecture*] is a
MORTER } Preparation of Lime and Sand, mixt up with Water, ſerving as a Cement, and us'd by Maſons and Bricklayers in Building of Walls of Stone and Brick.

For Plaiſtering of Walls, they make their Mortar of

Lime, and Ox or Cow Hair, tempered well together with Mortar.

Of making common Mortar] As to the Proportion of Lime and Sand to be us'd in making common Mortar, there are different Opinions.

Vitruvius ſays, you may put three Parts of Dug (or Pit-Sand) to one Part of Lime; but if the Sand be taken out of a River, or out of the Sea, then two Parts of it, and one of Lime. He alſo adds, that if to the River or Sea Sand, you put one third Part of Powder of Tiles or Bricks, it will work the better.

But *Vitruvius*'s Proportion of Sand ſeems too much, tho' he ſhould mean of Lime before it is ſlak'd; for one Buſhel of Lime before 'tis ſlak'd, will make five Pecks, after 'tis ſlak'd.

About *London* (where for the moſt Part Lime is made of Chalk) they put about 36 Buſhels of Pit Sand to 25 Buſhels of Quick Lime, that is, about a Buſhel and a half of Sand to a Buſhel of Lime.

In ſome Places they put after the Proportion of three Pecks of Sand to one Buſhel of Lime; in other Places a Buſhel and half of Sand, to a Buſhel of Lime.

In Effect, the Proportion of Lime to Sand in making of Mortar, ought to be according to the goodneſs or badneſs of theſe Materials, and is therefore rather to be regulated by the Judgment of experienc'd Workmen in each particular Country, than by any ſtated Proportions of Materials.

As to the Method of making of Mortar], Some Workmen are of Opinion 'tis the beſt Way not to uſe Mortar as ſoon as it is made; nor (in making it) to make the Lime run before it is mix'd with the Sand (as ſome do) but rather to throw the Sand on the Lime while it is in the Stones, before it is run, and ſo to mix it together, and then to wet it; by which Means (they ſay) it will be the ſtronger, and when it has lain a while before it is us'd, will not be ſo ſubject to blow and bliſter.

Others adviſe to let Mortar (when made) lie in a Heap two or three Years before it is us'd, which they ſay, will render it the ſtronger and better; they likewiſe ſay, the uſing of Mortar as ſoon as 'tis made, is the Cauſe of ſo many inſufficient Buildings.

Others adviſe, that in ſlaking of Lime, to wet it every where but a little (and not to over-wet it) and to cover every Laying or Bed of Lime (about the Quantity of a Buſhel) with Sand, as you ſlake it; that ſo the Steam or Spirit of the Lime may be kept in, and not fly away, but mix it ſelf with the Sand; which will render the Mortar conſiderably ſtronger, than if it were all ſlak'd at firſt, and the Sand thrown on altogether at laſt.

2. That all the Mortar ſhould be well beaten with a Beater, three or four times over, before it is us'd, by that Means to break

break all the Knots of the Lime well together; and they ſay, that the Air which the Beater forces into the Mortar at every Stroke, conduces very much to the Strength of it.

3. That when you deſign to build well, or uſe ſtrong Mortar for Repairs, you beat the Mortar well, and let it lie two or three Days, and then beat it well again, when it is to be us'd.

4. That Mortar be us'd as ſoft as may be in Summer Time; but pretty ſtiff or hard in Winter.

As to mixing and blending of Mortar, Mr. *Felibien* obſerves, that the ancient Maſons were ſo very ſcrupulous herein, that the *Greeks* kept ten Men conſtantly employ'd for a long Space of Time, to each Baſon, which rendred it of ſuch prodigious hardneſs, that *Vitruvius* tells us, the Pieces of Plaiſter falling off from old Walls, ſerv'd to make Tables.

And Mr. *Felibien* tells us, 'tis a Maxim among old Maſons to their Labourers, that they ſhould dilute it with the Sweat of their Brow, *i. e.* labour it a long Time, inſtead of drowning it with Water, to have done the ſooner.

Mr. *Worlidge* adviſes, that if you would have your Mortar ſtrong, where you cannot have your Choice of Lime, but can chuſe your Sand and Water, not to uſe that Sand that is full of Duſt; for all duſty Sand makes the Mortar weaker; and the rounder the Sand is, the ſtronger the Mortar will be, as is uſually obſerv'd in Water drift Sand; that it makes better Mortar than Sand out of the Pit.

Therefore he adviſes, that if you have Occaſion for extraordinary Mortar, to waſh your Sand in a Tub, till the Water, after much ſtirring, comes off clear, and to mix that with new Lime, and the Mortar will be very ſtrong and durable. And if the Water be foul, dirty, or muddy, the Mortar will be the weaker.

Wolfius obſerves, that the Sand ſhould be dry and ſharp, ſo as to prick the Hands when rubb'd; yet not earthy, ſo as to foul the Water it is waſh'd in.

He alſo finds Fault with Maſons and Bricklayers, as committing a great Error in letting their Lime ſlacken and cool before they make up their Mortar, and alſo in letting their Mortar cool and die before they uſe it; therefore he adviſes, that if you expect your Work to be well done, and to continue long, to work up the Lime quick, and but a little at a Time, that the Mortar may not lie long before it be us'd.

So that it appears, Men differ in their Opinions in this Point; ſome affirming it to be beſt to work up the Mortar new, and others, not till it has lain a long Time.

A certain Author tells us, that an experienc'd Maſon told him, that being at work at *Eridge-Place*, (at the Lord *Abergaveny*'s) at *Fant* in *Suſſex*, they would have him make

use of Mortar that had been made four Years. But when he came to try it, he said it was good for Nothing, because it was so very hard, that there was no tempering it. Upon which, a certain Jesuite (who resided in the House, and had been a great Traveller) told him, that to his Knowledge at several Places beyond Sea, they always kept their Mortar 20 Years before they us'd it; but then this Mortar was kept in Cisterns for the Purpose, and always moist.

The Ancients had a Kind of Mortar so very hard and binding, that after so long a Duration, 'tis next to impossible to separate the Parts of some of their Buildings; tho' there are some who ascribe that excessive Strength to Time and Influences of certain Properties in the Air, which is found to harden some Bodies very surprisingly.

De Lore observes, that the best Mortar is that made of *Puzzucli*; adding, that it penetrates black Flints, and turns them white.

The Lime us'd in the ancient Mortar is said to be burnt from the hardest Stones, and even the Fragments of Marble.

As for the scaling (or crimping) of Mortar out of the Joints of Stone and Brick-Walls, some are of Opinion it proceeds from the badness of the Sand or Lime, or both, as well as from the Season of Year when Work is done.

Besides the common Mortar us'd in laying Stones, Bricks, &c. there are several other Kinds, as

White Mortar, us'd in Plaistering the Walls and Ceilings, which are often first plaistered with Loam, and is made of Ox or Cow Hair, mix'd and temper'd with Lime and Water, without any Sand.

The common Allowance in making this Kind of Mortar is one Bushel of Hair to six Bushels of Lime; the Hair serves to keep the Mortar from cracking; binding it, and holding it fast together.

The MORTAR us'd in making Water Courses, Cisterns, &c. is very hard and durable, as may be seen at *Rome* at this Day. It is us'd not only in Building of Walls, but also in making of Cisterns to hold Water, and all manner of Water Works, and also in finishing or Plaistering of Fronts, to represent Stone Work.

There are two Kinds of it, the one is compounded with Lime and Hogs Grease, and mixt with the Juice of Figs; and the other is of the same Ingredients, but has liquid Pitch added to it, and is first wet or slak'd with Wine, and then pounded or beaten with Hogs Grease, and Juice of Figs.

That which has Pitch in it, is easily distinguish'd from the other by its Colour; and what is plaistered with this Kind of Mortar, is wash'd over with Linseed Oil.

Mortar for Furnaces, &c. is made with red Clay, wrought in Water, wherein Horse Dung and Chimney Soot has been steep'd, by which a Salt is communicated to the Water, bind-

binding the Clay, and making it fit to endure the Fire: This Clay ought not to be too fat, lest it should be subject to Chinks; nor too lean or sandy, lest it should not bind enough.

Some Operators in Metal, use a Kind of Mortar to plaister over the Inside of their Vessels in which they refine their Metals, to keep the Metal from running out; and this Kind of Mortar is made with Quick-Lime and Ox-Blood; the Lime being first beaten to powder, and sifted, and afterwards mixt with the Blood, and beat with a Beater.

The Glass-makers in *France* are said to use a Sort of Mortar (for plaistering over the Insides of their Furnaces) which is made of a Sort of Fuller's Earth, which is procur'd at *Beliere*, near *Forges*, which is the only Earth in *France* that has the Property of not melting in this excessive Heat; and also the Pots which hold the melted Metal, are made of this Sort of Earth, and will last a long Time.

Mortar for Sun-Dials on Walls, may be made of Lime or Sand tempered with Linseed Oil, and for Want of Linseed Oil, may be made of scumm'd Milk; but Oil is better: This spread upon the Wall, will harden to the hardness of a Stone, and not decay in many Years, and will endure the Weather six times as long as the ordinary Plaister, made of Lime and Hair with Water.

A certain Author says he has known a very strong and tough Mortar (for a Sun-Dial Plane) has been made after the following Manner.

There was taken five or six Gallons of Brook Sand, and dry'd on an Oast; and after that sifted through a fine splinted Sieve, and then mix'd with it the same Quantity, or rather something more of sifted Lime, and a Gallon of Boreing (or Gun) Dust sifted also; these were all wetted and well tempered with six or seven Gallons of scumm'd Milk, and about two Quarts of Linseed Oil.

This was laid on the Wall first, well wetted with Milk; but this prov'd very troublesome to the Workmen to set it smooth; by Reason that it dry'd so very fast; but by keeping it often sprinkled with Milk, and smoothing it with the Trowel, it did at last set with a smooth and shining Surface.

But notwithstanding all his Care (as it dry'd) it crack'd pretty much, which might probably proceed from the Want of Hair to it; it did also blow Blisters, tho' the Lime was sifted: which probably might have been prevented, if the Lime had been prepar'd as for *Fresco Painting*.

Extraordinary good Mortar for Floors, Walls, Ceilings, &c.

Temper Ox Blood and fine Clay together, then lay the same in any Floor, or plaister any Wall or Ceiling with it, and it will become a very strong and binding Substance. This is said by some to be much us'd in *Italy*.

In Buildings one Part of waſte Soap Aſhes mix'd with another of Lime and Sand, make a very durable Mortar.

This Mortar may be made, as it was by a certain eminent Soap Boiler, who built himſelf a very handſome Houſe with it in the following Proportions; two Load of waſte Soap Aſhes, one Load of Lime, one Load of Lome, and one of Sand.

Another Perſon of the ſame Trade us'd only Lime and Soap-Aſhes, tempered and wrought together for Mortar; with which he laid both the Foundations, Chimnies, and their Tunnels, in his Dwelling-houſe in *Southwark*; which have endur'd and ſtood out thoſe Storms which have overturn'd many other Tunnels, both new and old, which were built with common Mortar.

It is true indeed, this kind of Mortar is ſomewhat rough in the laying, and more ſharp and fretting to the Fingers than common Mortar; which may be the Reaſon why it is ſo much neglected and decry'd by Workmen.

But theſe two Inconveniences might be eaſily remedied; and indeed its Roughneſs is ſo far from being a Fault, that it is rather an excellent Quality in the Mortar. But this may be remedied, by grinding or ſtamping the Soap-Aſhes (which are in hard Cakes) to a fine Powder, before they are mix'd with the Sand, which will ſoon bring it to a ſmooth Temper.

Nor will the Charge be much; the Profit of one Day's Labour will anſwer the Charge of three Mens Wages, in the Difference of Price that will be found betwixt one Load of theſe Aſhes and one Hundred of Lime.

Secondly, As to the *Sharpneſs* wherewith it offends the Workmens Fingers, that may be avoided by wearing Gloves (without which they ſeldom lay any Brick at all) to avoid the like Effects which they find in Lime.

Or, for an aſſured Remedy in theſe Caſes; theſe Aſhes may be re-imbib'd in Water for a conſiderable Time, till more of their Salt be extracted from them; and then much of their fretting Nature being taken away, they will be found to be gentle enough.

For laying Tiles, in ſome Places they make a kind of Mortar of Lome and new Horſe Dung well tempered and mix'd together: And this is by ſome Workmen accounted a good, ſtrong, and cheap Mortar, which is more ſuitable to Tiles than the common Mortar made with Lime and Sand, which they ſay corrodes and frets the Tiles, and cauſes them to ſcale and fly to pieces; which this does not.

For the plaiſtering the Fronts of Houſes in imitation of *Brick-work*; Some Workmen make Mortar for this ſort of Work, of Powder of Brick, ſharp Sand and Lime, and ſome red Oker. Some Houſes plaiſtered with this kind of Plaiſter, look very well, tho' they have been done 20 or 30 Years, and may be taken, by one paſſing by, for a Brick Houſe, tho' it be only

Timber

Timber plaistered over. The Workman has for this sort of Work commonly 1 *s. per* Yard, only for Workmanship.

How much allow'd to a Rod of Brick-work, or a Square of Tileing.] Workmen usually allow a Hundred and half (or 37½ Bushels) of Lime, and two Load (or 72 Bushels of Sand) to make Mortar enough for a Rod of Brick-work.

And for Tileing; four Bushels of Lime, and six or eight Bushels of Sand, will make Mortar enough for laying 1000 of Tiles, which is about a Square and a half; so that a Square of Tileing will take up, for Mortar, about 2⅔ Bushels of Lime, and about five Bushels of Sand.

A Caution.] It is a general Caution in all Parts of a Building, that where either Stones or Bricks are contiguous to Wood, they ought to be laid, dry, or without Mortar; because Lime and Wood are unsociable; the Lime very much corroding and decaying the Wood.

MORTOISE, MORTISE [in *Carpentry*, &c.] is a kind of Joint, wherein a Hole or Incision of a certain Depth is made, in the Thickness of a Piece of Wood, which is to receive another Piece, call'd a Tenon.

MOSAIC WORK, MOSAIQUE Is a curious Piece of Work, or an Assemblage of Marble, pretious Stones, Pebbles, Pieces of Glass, *&c.* also Cockles and Shells of various Colours, cut square, and cemented on a Ground of Stuck, *&c.* in imitation of the natural Colour and Degradation of Painting.

As to the Name *Mosaic*, some derive it of *Musaicum*, as that is of *Musivum*, as it was call'd among the *Romans*. *Scaliger* derives it of *Moûsan*, *Gr.* and imagines the Name was given to this Sort of Work, as being fine and ingenious.

Mosaic Work seems to have taken its Origin from *Paving*. The fine Effect and Use of Pavements, compos'd of Pieces of Marble of different Colours, so artfully and neatly join'd together, that when the Work is dry, it may be polish'd, and the whole make a very beautiful and solid Body, which being continually trodden upon and wash'd with Water, was not at all damag'd, gave the Hint to the Painter, who in a little Time carried the Art to a much higher Degree of Perfection, so as to represent Foliages, and Grotesque Pieces of various Colours on a Ground of Marble, either white or black.

In fine, the good Effect of this Kind of Work in Pavements, being observ'd, and also its Quality of resisting Water, Artists proceeded farther, and also lin'd Walls with it, beautified with various Figures, for adorning Temples, and other publick Buildings.

But Nature not having produc'd a sufficient Variety of Colours for them in Marbles to represent all Kinds of Objects, they bethought themselves of counterfeiting them with Glass and

and Metal Colours, they having given Teints of all Manner of Colours, to an infinite Number of Pieces of Glass and Metals to counterfeit Stones of various Colours, the Design succeeded so well; the Workmen arrang'd them with so much Art, that their Mosaic seem'd to almost vye with Paintings.

This Way of representing Objects having this Advantage that it resists the Injuries of the Air as well as Marble it self; and even grows more beautiful by Time; which effaces all other Kinds of Paintings.

But the Moderns have gone beyond the Ancients; and setting aside Materials of Glass and Metals, have intermixt with the finest Marbles, the richest of precious Stones; as *Agats*, *Cornelians*, *Emeralds*, *Lapis*, *Turquoises*, &c.

So that the Mosaic Work of Glass and Metals, is now little in Use; tho' even they are of a surprising Beauty and Durableness: But that which is in the most common Use, is that of Marble alone; the Mosaic of precious Stones being so very costly, that scarce any but very small Works are made with them: As Ornaments for Altar-Pieces, Tables for rich Cabinets, *&c.*

Tho' out of these must be excepted, that sumptuous Chapel of the Dukes of *Tuscany*, which has been so long in Hand, and which, if it be ever finish'd, will be a noble Monument of the Magnificence and Piety of those Princes, as well as the Patience and Address of the Workmen employ'd in that Work.

Mosaic Work of Glass.

This Work is begun with little Pieces of Glass, which they provide of as many different Colours as possible.

For this Purpose the Glass-Makers Furnaces being prepar'd and put in Order, and the Pots or Crucibles full of the Matter of which Glass is made, or rather of Glass, already made; they put what Colours they think proper into each Crucible, always beginning with the weakest, and augmenting the Strength of the Colours from Crucible to Crucible, till they come to the deepest Shade or Teint, much after the Manner of mixing Oil Colours on a *Palette*. When the Glass has been well melted and ting'd with all the Colours to Perfection, the Crucibles are taken hot out of the Furnace, and the Glass is poured on a smooth Marble, and so cut into Slices of an Inch and an half thick.

Then with an Instrument which the *Italians* call *Bocca di Cane*, they make some Pieces square, and others of different Figures and Sizes, according as the Design requires.

The Pieces are orderly disposed in Cases; as in Painting *in Fresco* it is usual to range all the different Teints in Shells, and according to their Colour.

If they would have a Gold Colour, either in the Ground of the Painting, or in the Ornaments, or the Draperies, they take

take ſome of the Pieces of Glaſs, form'd and cut in the Manner before mentioned. Theſe they moiſten on one Side with Gum Water, and afterwards lay Leaf Gold on it.

They then put this Piece, or ſeveral Pieces at a time, on a Fire-ſhovel, which they place in the Mouth of the Furnace, after having firſt covered them with another hollow Piece of Glaſs.

Here they continue till ſuch Time as they become red hot; after which the Shovel is drawn out all at once, and the Gold becomes ſo firmly attach'd to the Glaſs, as never afterwards to be ſeparated from it.

Now, to apply theſe ſeveral Pieces, and to form a Picture out of them, they have a Cartoon or Deſign firſt drawn: This is transfer'd on the Ground or Plaiſter by calking, as in painting *in Freſco*.

As this Plaiſter is to be laid thick on the Wall, it will continue freſh and ſoft a conſiderable time; ſo that there may be enough prepared at once to ſerve three or four Days.

This Plaiſter is compoſed of Lime, made of hard Stone, with Brick Duſt made very fine, Gum Tragacanth, and Whites of Eggs. When this has been prepar'd and laid on the Wall, and the Deſign of what is to be repreſented drawn on it, they take out the little Pieces of Glaſs with Plyers, and range them one after another, ſtill keeping ſtrictly to the Light and Shadow, different Teints and Colours before repreſented in the Deſign; preſſing or flatting them down with a Ruler; which both ſinks them within the Ground, and at the ſame time renders the Surface even.

After this manner, in much Time, and an almoſt infinite deal of Trouble, they at length finiſh the Work; which is ſtill the more beautiful as the Pieces of Glaſs are the more uniform, and ranged at more equal Heights.

Some of theſe Pieces have been executed with ſo much Juſtneſs, that they appear as ſmooth as a Table of Marble; and as finiſh'd and as maſterly as a Painting *in Freſco*; with this Advantage, that they have a fine Luſtre, and will laſt almoſt for ever.

The fineſt Works of this Kind that have been preſerved to our Time, and thoſe from which the Moderns have retriev'd the Art, which was almoſt loſt, are thoſe of the Church of St. *Agnes*, formerly the Temple of *Bacchus* at *Rome*; at *Piſa*, *Florence*, and other Cities of *Italy*.

The moſt eſteemed among the Works of the Moderns, are thoſe of *Joſeph Pine*, and the Chevalier *Lanfranc*, in the Church of St. *Peter* at *Rome*: But there are alſo very good ones at *Venice*.

Moſaic Work *of Marble and precious Stones*.

Theſe two Kinds of *Moſaic* bear ſo near a Relation to each other as to the manner of working, that to avoid Repetition, I ſhall give them both

under

under one; obſerving by the way, wherein the one is different from the other.

Moſaic of Marble is us'd in large Works, as in Pavements of Churches, Baſiliſks and Palaces; and Incruſtation and vanneering the Walls of the ſame Edifices.

As to *Moſaic*, of or with Stones, eſpecially *precious Stones*, it is only uſed in ſmall Works, as has been before obſerv'd.

The Ground of *Moſaic* Works, wholly of Marble, is uſually a maſſive Marble, either white or black. On this Ground the Deſign is cut with a Chiſel, having been firſt calked.

When it has been dug of a ſufficient Depth, *i. e.* an Inch, or more, 'tis filled up with Marble of a proper Colour, firſt contourniated or faſhioned to the Deſign, and reduc'd to the Thickneſs of the Indentures with various Inſtruments.

To make the Pieces thus inſerted into the Indentures, hold the ſeveral Colours which are to imitate thoſe of the Deſign, they uſe a Stuck compoſed of Lime and Marble Duſt; or a Maſtick; which different workmen prepare different ways; after which the Work is half poliſh'd with a kind of ſoft Stone.

The Figures being mark'd out, the Painter or Sculptor himſelf draws with a Pencil the Colours of the Figures not determined by the Ground, and in the ſame manner makes Strokes or Hatchings in the Places where the Shadows ought to be; and when he has engraven with the Chiſel all the Strokes thus drawn, he fills them up with a black Maſtick, compos'd partly of *Burgundy* Pitch, poured on hot; afterwards taking off what is ſuperfluous, with a Piece of ſoft Stone or Brick; which together with Water and beaten Cement takes away the Maſtick, poliſhes the Marble, and renders the Whole ſo even, that it ſeems as if it conſiſted but of one intire Piece.

It is this kind of *Moſaic* that is ſeen in the pompous Church of the *Invalids* at *Paris*, and the fine Chapel at *Verſailles*; and with which ſome intire Apartments of that Palace are incruſtated.

As for *Moſaic Work of precious Stones*, other and more delicate Inſtruments are required, than thoſe that are uſed in Marbles; as Wheels, Drills, Tin-plates, &c. ſuch as Lapidaries and Engravers on Stone uſe.

As none but the richeſt Marbles and Stones enter this Work, in order to make them go the farther, they are ſawn into the thinneſt Leaves that can be, ſcarce exceeding half a Line in Thickneſs. The Block that is to be ſawn, is faſtened firmly with Cords on the Bench, only raiſed a little on a Piece of Wood of one or two Inches high.

The Saw is directed by two iron Pins, which are on one Side of the Block, and which alſo ſerve to faſten it; which with the Pieces ſo ſawn are put into a Vice contrived for that

Pur-

Purpoſe; and with a kind of Saw, or Bow, made of fine Braſs Wire, bent on a Piece of ſpringy Wood, together with Emery ſteep'd in Water, the Leaf is gradually faſhioned, by following the Strokes of the Deſign made on Paper, and glued on the Piece.

When there have been Pieces enough faſtened to form an intire Flower, or ſome other Part of the Deſign, they are applied. The Ground that ſupports this *Moſaic*, is uſually of Free Stone. The Matter wherewith the Stones are joined together, is a Maſtick, or kind of Stuck, laid very thin on the Leaves as they are faſhioned; and the Leaves in this State are applied with Pliers.

If any Contour or Side of a Leaf be not either rounded enough or ſquared enough to fit the Place where it is to be uſed; when 'tis too large, 'tis brought down with a Braſs File or Raſp; and when too ſmall, is manag'd with a Drill and other Inſtruments uſed by Lapidaries.

The Manner of making Moſaic Work *of Gypſum.*

The Gypſum is a kind of courſe Talc, or a ſhining tranſparent Stone found in the Quarries of *Montmartre* near *Paris*, among the Stones dug out of that Quarry, with which the Plaiſter of *Paris* is made. It is different from the Plaiſter; but retains the Name the *Romans* gave the Plaiſter, *viz. Gypſum*.

A kind of artificial Marbles are made of this Stone, calcin'd in a Kiln, and pounded in a Mortar, and afterwards finely ſifted. Theſe Marbles imitate precious Stones; and of theſe they compoſe a kind of *Moſaic* Work; which does not fall far ſhort, either in Durableneſs or Vivacity, of the natural Stones; and beſides, it has this Advantage, that it admits of continued Pieces or Paintings of intire Compartments, without any viſible Joinings.

Some make the Ground of Plaiſter of *Paris*; others of Free Stone. If it be made of Plaiſter of *Paris*, it is ſpread on a wooden Frame, of the Length and Breadth of the Work it is deſigned for, and about an Inch and half in Thickneſs. This Frame is ſo contrived that the Tenons being only joined to the Mortoiſes by ſingle Pins, they may be taken aſunder, and the Frame diſmounted when the Plaiſter is dry.

This Frame is covered on one Side with a ſtrong linen Cloth, nail'd all around; which being plac'd horizontally, with the Cloth at the Bottom, is filled with Plaiſter paſs'd through a wide Sieve.

The Plaiſter being grown half dry, the Frame is ſet up perpendicular, and let ſtand ſo, till it is quite dry; and then is taken out, by diſmounting the Frame.

In this Kind of *Moſaic*, the Ground is the moſt important Part.

The

The Method of preparing this ſifted *Gypſum*, which is to be apply'd on this Ground, is by diſſolving and boiling it in *Engliſh* Glue, and afterwards mixing with it the Colour that it is to bear: The Whole being work'd up together in the ordinary Conſiſtence of a Plaiſter; and then it is taken and ſpread on the Ground five or ſix Inches thick.

This is to be obſerv'd: If the Work be ſuch as that Mouldings are requir'd, they are form'd with Gouges and other Inſtruments.

On this Plaiſter thus colour'd like Marble or precious Stone, and which is to ſerve as a Ground to a Work, either of *Lapis*, Agate, Alabaſter, or the like, the Deſign to be repreſented is drawn; having been firſt pounced or calked, to hollow or impreſs the Deſign; the ſame Inſtrument is us'd as is us'd by Sculptors; the Ground on which they are to work not being much leſs hard than Marble it ſelf. The Cavities being thus made in the Ground, are filled up with the ſame Gypſum boil'd in Glue; only differently colour'd: And after this manner are the Colours in the Original repreſented.

That they may have the neceſſary Colours and Teints at hand, they firſt temper Quantities of the Gypſum with the ſeveral Colours in little Pots.

When they have thus filled the Deſign, and render'd it viſible by half poliſhing it with Brick or ſoft Stone, they go over it again, cutting ſuch Places as are either to be weaker or more ſhadowed, and filling them with *Gypſum*; which is repeated till all the Colours added one after another, repreſent the Original to the Life.

The Work being finiſh'd, is ſcowred with ſoft Stone, Sand, and Water; then with Pumice, and poliſh'd with a wooden Mullet and Emery.

Laſtly, the Luſtre is given it by ſmearing it over with Oil, and rubbing it a long Time with the Palm of the Hand; which gives it a Luſtre nothing inferior to that of natural Marble.

If it be only requir'd to make a variegated Table, or other Work of ſeveral Colours, without *Moſaic* Figures, the Proceſs is ſomewhat different.

To perform this, they only prepare ſeparately as many different Colours as the Work requires, in Imitation of Marble: Theſe are put into large Pans or Bowls, and after they have been incorporated in the *Gypſum* and Glue Water, they take a Trowel full of each, and diſpoſe them in a Trough without any Order; then without mingling them, and only by cutting or croſſing the *Gypſum* of each Trowel once or twice with each of the Reſt, they give them that beautiful Confuſion, which makes the Value of natural Marbles: Of theſe they make their Tables, or lay them in a Mould, according to the Work to be done.

MOSS [*us'd in Tileing*]. In ſome Places in the Country, they lay Tiles in Moſs inſtead of

of Mortar: But this is disapprov'd by some Workmen, because they say, in windy, wet Weather, when the Wet, Rain, Slow, or Sleet is driven under the Tiles in the Moss, if a Frost follows while the Tiles are wet, it then freezes the Moss, and so raises the Tiles out of their Place.

MOTION is a continual and successive Mutation of Place, and is either Absolute or Relative.

1. *Absolute* Motion is the Change of the *Locus Absolutus* of any moving Body; and therefore its Celerity will be measured by the Quantity of the Absolute Space, which the moveable Body hath run thro'. But,

2. *Relative Motion*, is a Mutation of the Relative or Vulgar Place of the moving Body, and so hath its Celerity accounted or measured by the Quantity of Relative Space, which the moveable Body runs over.

3. All Motion is of it self rectilinear, or made according to strait Lines, with the same constant uniform Velocity, if no external Cause makes any Alteration in its Direction.

4. If two Bodies moving uniformly, go with unequal Velocities, the Spaces which will be pass'd over by them in unequal Times, will be to one another in a Ratio, compounded of that of the Velocities, and that of the Times.

5. The Motions of all Bodies, are as the Rectangles under the Velocities, and the Quanties of Matter.

6. The Motions of Bodies included in a given Space among themselves, will not be changed by the Motion of that Space uniformly forwards in a strait Line.

7. Every Body will continue in its State, either of Rest or Motion uniformly forward in a right Line, unless it be made to change that State by some Force impress'd upon it.

8. The Change of Motion is proportionable to the moving Force impress'd, and is always according to the Direction of that Right Line, in which the Force is impress'd.

9. The Quantity of any Motion is discoverable by the joint Consideration of the Quantity of Matter in, and the Velocity of the moving Body; for the Motion of any whole is the Sum of the Motions of all the Parts.

10. The Quantity of Motion which is found by taking either the Sum of the Motions made the same Way, or the Difference of those which are made the contrary Ways is not at all changed by the Actions of the Bodies one upon another.

11. In all kind of Motions whatever, *Rolling*, *Sliding*, uniform, accelerated or retarded, in right Lines or in Curves, *&c.* the Sum of the Forces which produce the Motion of all Parts of its Duration, is always proportionable to the Sum of the Paths or Lines, which all the Points of the moving Body describe.

12. The Product of the Duration

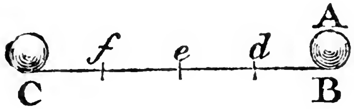
ration of all uniform Motion, multiply'd by the Force, which began the Motion, is always proportional to the Product made by the Path or Line of Motion, multiply'd by the Mass or Quantity of Matter in the moving Body.

MOTION [in *Mechanicks*] is the opposite to the Rest, it is either general or particular, and those are either Regular or Irregular.

Motion in general, is the *Change* of a Thing; and when that *Change* is made in the Quantity, it is call'd an *Increase* or *Diminution*.

Again, when the Change is made, in Respect to Place, it is call'd *Place Motion*, or *Local Motion*.

Local MOTION } [in *Mechanicks*]
Place MOTION }
is the change of Place, or it is the continual Passage of a Body that moves from one Place, as the Passage of the Body A, from the Place B, into the Place C. For by its being mov'd to C, it has chang'd its Place from B to C.



Secondly, If the Body A, as it moves to C, goes through equal Spaces in equal Times, then its Motion is said to be *equal*; that is, if B *d* is = *d e*, and the body A pass from B to *d*, in the same Time as it does from *d* to *e*, then it will have pass'd through equal Spaces in equal Times, whereby its Motion is said to be *regular* or *equal*.

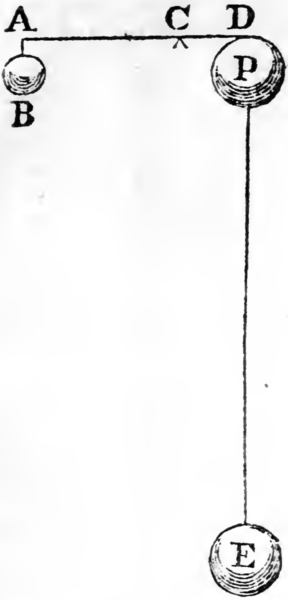
But if the Body A had mov'd from *d* to *e*, in less Time than it did from A to *d*, then its Motion had been irregular; because it would have pass'd through equal Spaces in unequal Times.

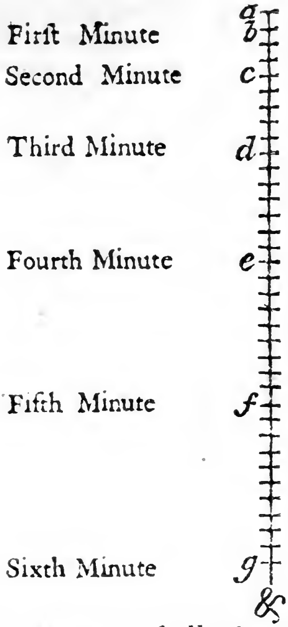
Hence, (as *Galilæus* observes) an irregular Motion is natural to all heavy Bodies, which he justly terms a *Motion uniformly accelerated*, as a Body dropt from the Top of a Steeple to the Earth, which in equal Times, passes through unequal Spaces.

That is to say, that dividing the Time it takes up in falling into equal Spaces, as Minutes, Seconds, &c. The Velocity of the falling Body at the End of the second Minute, &c. is double what it was at the End of the first, being reckon'd from the Point or Beginning of its Rest or Fall.

And that the Velocity which it acquires in the third Minute, &c. is triple of that which it had at first. And the Velocity of the fourth Minute. &c. four times that of the first, and so on in like Proportion of all other.

Thus if in the first Minute a Body falls from *a* to *b*; in the second Minute it will have fallen to *c*, and have pass'd thro' three times the Space of *a b*, which with the Space *a b*, is equal to four, which is the Square of two, the Number of Minutes.





Again.

At the End of the third Minute it will have fallen to D, and have pass'd through five times the Space *a b*, which with the Space *a b*, and *b e*, is equal to 9, which is the Square of 3, the Number of Minutes or Time of falling; and so in like Manner of all other Minutes, *&c.*

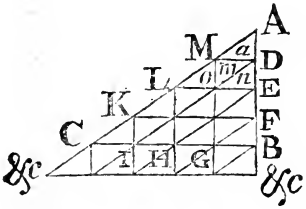
Hence it follows, that the Spaces through which Bodies fall, are as the Squares of the Times or Minutes, *&c.* in falling; that is if in one Minute a Body falls one Foot.

Then in	2	It will have fallen	4	From the Point of Rest.
	3		9	
	4		16	
	5		25	
	6		36	
	7		49	
	8		64	
	9		81	
	10		100	
	&c.		*&c.*	

Hence it is evident that the Increase of Motion in every Minute, *&c.* is according to the Series of the uneven Numbers, 1. 3, 5, 7, 9, 11, *&c.* which are the Differences of the Squares, 1, 4, 9, 16, 25, 36, *&c.*

By the *fourth Prop. 6 Lib. Euclid.* similar ▽ are to one another

another, as the Squares of their Homologus Sides; one may consider the Spaces pass'd thro' in equal Minutes as similar Triangles ▽ and the Minutes and Velocities, as the homologous Sides of those Triangles.



This is easily understood by the Triangular Figure above, which is suppos'd to be the Space pass'd through by the Body falling, which for Example Sake, is suppos'd to have fallen in four Seconds of Time, whose Measure is represented by the Side A B, equally divided at D E F B into four = Parts; and the Base B C shall likewise represent the Velocity which the Body has acquir'd in falling.

Now as each of the equal Parts, A D, D E, E, F, and F B, represent one Second of Time: so likewise, if B C be divided into four equal Parts, as B G, G H, H I, and I C, each of those Parts, will represent one Degree of Velocity, because 'tis suppos'd, that the Velocities and Seconds increase continually in the same Proportion.

Again.

If from the Points I H G, you draw Right Lines parallel to A C, and to A B, also intersecting A B in the Points D E F, and A C in the Points M L K, the Triangle A B C will be divided into 16 little Triangles = one to another, and each similar to A B C.

Now since A D represents the first Second of Time, and D M the first Degree of Velocity: therefore the Triangle A D M, will represent the Space which the Body has pass'd through in the first Second, with one Degree of Velocity.

So likewise the Line A E, representing the Second of the Fall of the said Body, the Line E L will represent the Velocity which the Body has acquir'd in falling the Second Second of Time, and the Triangle A E L will represent the Space that the Body has pass'd thro' with two Degrees of Velocity, which triangular Space A E L is equal to four Times A D M; because the ▽ *a* is = equal to the ▽ *m*, and the triangle *m*, is equal to the ▽ *n*, and the Triangle *n* is equal to the ▽ *o*; therefore the ▽ A E L, is equal to four times the ▽ A D M, and so in like Manner of all other equal Spaces of Time.

Hence it is evident, that the Velocity with which heavy Bodies descend, is according to the Squares of their Times;

So whatever Space a Body passes through, by falling in one Second, or one Minute, &c. So many times that first Space the Body falls, are equal to the Square of its times.

That is, if a Body falls one Foot in one Minute, then it will have fallen 100 Foot in 10 Minutes,

nutes, and 144 Foot in 12 Minutes, because 100 is the Square of 10, multiply'd by 10, and 144 is the Square of 12, multiply'd by 12.

MOULD [in *Mechanic Arts*] A Cavity artfully cut, with Design to give its Form or Impression to some softer Matter applied therein, and are Instruments of great use in Sculpture, Foundery, *&c.*

Workmen employ'd in melting the mineral or metallic Glebe dug out of Mines, have each their several Mould, to receive the melted Metal as it comes out of the Furnace; but different according to the Diversity of Metals and Works.

In the Gold Mines they have Moulds for Ingots, in Silver Mines for Bars, in Copper or Lead Mines for Pigs or Salmons, in Tin Mines for Pigs and Ingots, and in Iron Mines for Sows, Chimney-Backs, Anvils, Caldrons, Pots, and other large Utensils and Merchandizes of Iron, which are here cast, as it were at the first Hand. See CENTRE.

MOULDINGS [in *Architecture*] are Projectures beyond the naked of a Wall, Column, Wainscot, *&c.* the Assemblage of which, forms Cornishes, Door-Cases, and other Pieces of Architecture, which only serve for Ornament; whether they be square, round, strait or crooked: Of these there are seven Kinds more considerable than the Rest, *viz.* the *Doucine*; the *Talon* or *Heel*; the *Ovolo*, or *Quarter Round*; the *Plinth*, the *Astragal*, the *Denticle*, and the *Cavetto*.

Some *Mouldings* are crown'd with a *Fillet*, others are without, as the *Doucine*, *Talon*, *Ovolo*, *Torus*, *Scotia*, *Astragal*, *Gula*, *Corona*, &c.

Again, Some are adorn'd with Sculptures, either hollowed, or in Relievo.

Mouldings [in *Architecture*] are what Letters are in *Writing*. By the various Dispositions and Combinations of *Mouldings*, may be made an infinite Number of different Profiles for all Sorts of Orders and Compositions, regular or irregular, and yet all the Kinds of *Mouldings* may be reduc'd to three, *viz.* square, round, and mixed; *i. e.* compos'd of the other two.

For this Reason, those who invented the *Gothick* Architecture; resolving to recede from these perfect Figures, and affecting to use others less perfect, to distinguish their Architecture from the Antique, introduc'd a new Set of whimsical *Mouldings* and Ornaments.

Regular *Mouldings* are either large, as *Doucines*, *Ovolos*, *Gulas Talons*, *Scotia's*, &c. or small, as *Fillets*, *Astragals*, *Conges*, &c.

Mr. *Le Clerc* says, that Ornaments are not always us'd on *Mouldings*, barely to inrich them, but sometimes also to inrich, and sometimes also to distinguish them the better from one another.

As the Generality of *Mouldings*, and in particular those of Cornishes are only illumin'd by Reflection, they would be frequently confounded and lost, if

they were all ſimple and uniform; but a few Ornaments cut ſome one Way, and ſome another, diſtinguiſh them advantageouſly from each other.

Thus the Eggs have a noble Effect underneath the Larmier of the *Ionick* Order, or underneath the ſquare Member, whence the *Modillions* proceed in the *Corinthian*, as in his Figure 67; becauſe thoſe Ornaments, being cut ſtrong and bold, make an agreeable Difference between the *Mouldings* that accompany them.

Among theſe Ornaments, ſome ſtand prominent from the *Mouldings*, and others are cut within them, as may be obſerv'd in the ſeveral Figures of his 118 Plate.

Ornaments, he ſays, are not to be beſtow'd indifferently every where upon *Mouldings*; ſome Members or *Mouldings*, muſt be reſerv'd plain to ſet off the Reſt, and without the Simplicity and Plainneſs of theſe, the Richneſs of Ornaments would only make a Confuſion in Architecture, a ſenſible Inſtance of which we have in the *Corinthian* Profile taken from the Baths of *Diocleſian*, and mention'd in the Parallel of M. *de Chambray*. The *Corona* for Inſtance, is the firſt maſter *Moulding* in the *Corniche*, which will not admit of Ornaments, the *Faces* of the *Architrave*, the *Fillets*, *Liſt* or *Liſtels*, the *Aſtragal*, and all the Parts of the *Baſe*.

MOULINET [in *Mechanicks*] 'tis us'd to ſignify a *Roller*, which being croſsd with 2 *Levers*, is uſually apply'd to Cranes, Capſtans and other Sorts of Engines of the like Nature, to draw Cords and raiſe Stones, Timber & ſuch like heavy Materials. Alſo a kind of *Turn-Stile* or wooden Croſs, which turns horizontally upon a Stake fix'd in the Ground, and is uſually plac'd in Paſſages to keep out Horſes, and oblige Paſſengers to go and come one by one.

MOVEMENT [in *Mechanicks*] is the ſame that is by ſome call'd an *Autometon*, and with us ſignifies all thoſe Parts of a Clock, Watch or any ſuch curious Engine, which are in Motion, carry on the Deſign, or anſwer the End of the Inſtrument.

MULTANGULAR Figure or Body, is one that has many Angles or pointed Corners.

MULTILATERAL [in *Geometry*] is ſaid of thoſe Figures which have more than four Sides or Angles.

MULTINOMIAL *Roots*, [in *Mathematicks*] are ſuch as are compos'd of many Names, Parts or Members.

MULTIPLE } [in *Arithmetick*].
MULTIPLEX }

a Number which comprehends ſome other Number ſeveral Times.

Thus 6 is a *Multiple* of 2; or which is the ſame; 2 is a quota Part of 6; 2 being contained in 6, 3 times, and thus 12 is a *Multiple* of 6, 4, 3, and comprehends the firſt, twice; the ſecond, three Times, and the third, four times.

Multiple *Proportion*, is when the antecedent being divided by the Conſequent, the Quotient is more than Unity; and the

the Reason of the Name is, because the Consequent must be multiply'd by the Index or Exponent of the Ratio to make it equal to the Antecedent.

Thus 12 is the *Multiple* in Proportion to 4, because being divided by 4, the Quotient is 3, which is the Denomination of the Ratio; and the Consequent 4 being multiply'd by 3, makes the Antecedent 12, wherefore 3, is the *Sub-multiple* of 12.

A *Sub-multiple* Number is that contain'd in the *Multiple*, thus, the Number 1, 2, and 3, are *Sub-multiples* of 6 and 9.

MULTIPLICAND [in *Arithmetick*] is the Number to be multiply'd.

MULTIPLICATOR is the Number by which you multiply, or the Number multiplying.

MULTIPLICATION, is in general, the taking or repeating of one Quantity, as often as there are suppos'd Unites in the other Number; the Number multiply'd is call'd the *Multiplicand*, the Number multiplying, the *Multiplicator*, and that which is found or produc'd is call'd the *Product*.

Multiplication is only a compendious Addition, effecting at once, what in the ordinary Way of Addition would require many Additions; for the *Multiplicand* is only added to itself or repeated as often as the Unites of the *Multiplicator* do express it.

Thus if 6 were to be multiply'd by 4, the Product is 24, which is the Sum arising from the Addition of 6 four times to itself.

In all Multiplication, as 1 is to the Multiplicator, so is the Multiplicand to the Product.

Cross MULTIPLICATION, or Multiplication of Feet and Parts.

Example 1. Let 7 Feet 9 Inches be multiply'd by 3 Feet 6 Inches.

F.	I.	
7	9	
3	6	
23	3	Pts.
3	10	6
27	1	6

First, multiply 9 Inches by 3, saying 3 times 9 is 27 Inches, which make 2 Feet 3 Inches; set down 3 under Inches, and carry 2 to the Feet, saying 3 times 7 is 21, and 2 that I carry makes 23; set down 23 under the Feet.

Then begin with 6 Inches, saying, 6 times 9 is 54 Parts; which is 4 Inches and 6 Parts; set down 6 Parts, and carry 4, saying 6 times 7 is 42, and 4 that I carry is 46 Inches, which is 3 Foot 10 Inches, which set down, and add all up together, and the Product will be 27 Feet, 1 Inch, and 6 Parts.

Example 2. Multiply 75 Feet 7 Inches, by 9 Feet 8 Inches.

F.	I.
75	7
9	8
680	3
50	4 : 8
730	7 : 8

First, Multiply by 9 Feet, saying 9 times 7 is 63, which is 5 Feet 3 Inches; set down 3 and carry 5, saying 9 times 5 is 45, and 5 I carry is 50; set down 0 and carry 5, saying 9 times 7 is 63, and 5 that I carry is 68, set down 68, and proceed to multiply by 8 Inches, saying, 8 times 7 is 56, the twelves in 56 are 4 times, and there remains 8; set 8 in a Place to the right Hand, and carry 4; then multiply 75 by 8, and the Product is 600, and 4 that I carry is 604, which divided by 12, the Quotient is 50 Feet, and 4 remains; then set down 50 Feet and 4 Inches, and add all together, and you will find the Product 730 Feet, 7 Inches, 8 Parts.

I shall shew another Way of working the last Example, which in my Opinion is better and more expeditious, when there are more Figures than one in the Feet, thus.

F.		I.		
75		7		
9		8		
680		3		
25	:	2	:	4
25	:	2	:	4
730	:	7	:	8

Multiply by 9 Feet first, as above directed; then instead of multiplying by 8 Inches, let the 8 Inches be parted into such aliquot or even Parts of a Foot, as you find to be contain'd in that Figure; if you take such Parts of the Multiplicand and add them to the former Product, the Sum will give the Answer.

Thus 8 Inches may be parted into 4 and 4, because 4 is the third Part of 12. So that if you take the third Part of 75 Feet 7 Inches, and set it down twice and add all together, the Sum will be 730 Feet 7 Inches 8 Parts, the same as before.

Thus, say how often 3 in 7, which is twice, set down 2; then because twice 3 is 6, say 6 out of 7, and there remains 1, for which you must add 10 to the 5, and it makes 15; then the 3 in 15 are 5, set down 5, and because 3 times 5 is 15, there is 0 remains.

Then go to the 7 Inches, saying the threes in 7 are twice; set down 2 in the Inches; and because twice 3 is but 6, take 6 out of 7, and there remains 1 Inch, which is 12 Parts, then the threes in 12 are 4 times, and 0 remains. So the third Part of 75 Feet 7 Inches, is 25 Feet, 2 Inches, 4 Parts; which set down again, and add all together; and the Sum will be 730 Feet, 7 Inches, 8 Parts, the same as before.

Example 3. Let 97 Feet 8 Inches, be multiply'd by 8 Feet 9 Inches.

F.		I.
97	:	8
8	:	9
481	.	4
48	:	10
24	:	5
854	:	7

Begin first to multiply 8 Feet, saying 8 times 8 is 64 Inches, that is 5 Feet 4 Inches; set down 4 Inches and carry 5, saying

ſaying, 8 times 7 is 56, and 5 I carry, is 61; ſet down 1 and carry 6, ſaying 8 times 9 is 72, and 6 I carry is 78, which ſet down: Then inſtead of multiplying by 9 Inches, take the Aliquot Parts of 12, which 9 makes, which is 6 and 3, 6 Inches being half 12, and 3 the fourth Part; therefore take the half of 97 Feet 8 Inches, which is 48 Feet 10 Inches; and becauſe 3 is half of 6, you may take the half of 48 Feet 10 Inches, which is 24 Feet 5 Inches; add all up together, and the Sum is 854 Feet 7 Inches.

Example 4. Multiply 75 Feet 9 Inches, by 17 Feet 7 Inches.

F.		I.	
75		9	
17		7	
525			
75			
25	:		3 *parts.*
18	:	11	3
8	:	6	
4	:	3	
1331	:	11 : 3	

In this Example, becauſe there are more than 12 Feet in the Multiplier, therefore I firſt multiply the 75 by 17 Feet, then becauſe the Aliquot Parts in 7 Inches are 4 and 3, that is, a third and a fourth, take the third Part of 75 Feet 9 Inches, which is 25 Feet 3 Inches, and the fourth Part thereof is 18 Feet 11 Inches, 3 Parts, and then the Aliquot Parts of 9 Inches, are 6 and 3, that is a half and a fourth; therefore I take half 17 Feet, which is 8 Feet 6 Inches, and the fourth, is 4 Feet 3 Inches (not meddling with the 7 Inches, becauſe that was multiply'd into the 9 before) then add all theſe together, and the Sum is 1331 Feet, 11 Inches, 3 Parts.

Example 5. Let 87 Feet 5 Inches, be multiply'd by 35 Feet 8 Inches.

F		I.		P.
87	:	5		
35	:	8		
435				
261				
29	:	1	:	8
11	:	8	:	0
2	:	11	:	0
3117	:	10	:	4

Work this as the laſt Example; after you have multiply'd the Feet, then take the Aliquot Parts of 8 Inches, which is two thirds; therefore take the third Part of 87 Feet 5 Inches, which is 29 Feet, 1 Inch, 8 Parts; ſet this down twice; then the Aliquot Parts of 5 Inches, are 4 and 1, that is; a third Part and a twelfth Part; therefore take a third Part of 35, which is 11 Feet 8 Inches, and a twelfth Part of 35 Feet, is 2 Feet 11 Inches; ſet all theſe one under another, and add them together, and the Sum will be 3117 Feet, 10 Inches, 4 Parts.

Example 6. Multiply 259 Feet

Feet 2 Inches, by 48 Feet 11 Inches.

F.	I.	P.
259	2	
48	11	
20072		
1036		
129	7	
86	4	8
31	7	2
8	0	0
12677	6	10

First. Multiply the Feet; then take the Aliquot Parts of 11, which will be 6 4 and 1; that is, a half, a third, and a twelfth; therefore take the half of 259 Feet, 2 Inches, which is 129 Feet 7 Inches, and a third Part is 86 Feet 4 Inches 8 Parts; and the twelfth Part of 259 Feet 2 Inches, is 21 Feet 7 Inches 2 Parts (or because 1 is the fourth Part of 4) you may more readily take the fourth Part of 86 Feet, 4 Inches 8 Parts) which is also 21 Feet, 7 Inches, 2 Parts; then add all together, and the Sum will be 12677 Feet, 6 Inches and 10 Parts.

To multiply Feet, Inches and Parts.

Example 1. Multiply 7 Feet 5 Inches, 9 Parts, by 3 Feet, 5 Inches, 3 Parts.

In this Example I first begin with 3 Feet, and there multiply 7 Feet, 5 Inches, 9 Parts; first I say, 3 times 9 is 27 Parts, that is 2 Inches and 3 Parts; set down 3 under the Parts, and carry 2, saying 3 times 5 is 15, and 2 I carry, is 17, that is 1 Foot 5 Inches, set down 5 Inches and carry 1, and say 3 times 7 is 21, and 1 I carry is 22; set down 22 Feet.

F.	I.	P.	S.	T.
7	5	9		
3	5	3		
22	5	3		
3	1	4	9	
	1	10	5	3
25	8	6	2	3

Then begin with 5 Inches, saying, 5 times 9 is 45, which is 45 Seconds, which make 3 Parts and 9 Seconds; set down 9 Seconds a Place towards the right Hand, and carry 3 Parts, saying 5 times 5 is 25, and 3 I carry is 28, which is 2 Inches and 4 Parts; set down 4 Parts, and carry 2, saying 5 times 7 is 35, and 2 I carry is 37, which is 3 Feet and 1 Inch; set down the 3 Parts and 1 Inch, and begin to multiply by 3 Parts, saying 3 times 9 is 27 thirds, that is 2 Seconds and 3 Thirds; set down 3 Thirds and carry 2, saying, 3 times 5 is 15, and 2 I carry is 17, that is 1 Part and 5 Seconds; set down 5 Seconds and carry 1. Saying 3 times 7 is 21, and 1 I carry, is 22; which is 1 Inch and 10 Parts, which set down and add all up together, and the Product will be 25 Feet, 8 Inches, 6 Parts, 2 Seconds, and 3 Thirds.

You

You are to take Notice, that in multiplying *Feet*, *Inches* and *Parts*, &c. if *Feet* be multiply'd by *Feet*, the Product is *Feet*; and *Feet* multiply'd by Inches, the Product is *Inches*, and the twelfth Part is *Feet*; and *Parts* multiply'd by *Feet*, the Product is *Parts*, and the twelfth Part thereof is *Inches*; *Parts* multiply'd by *Inches*, the Product is *Seconds*, and the twelfth Part thereof is *Parts*; and *Parts* multiply'd by *Parts*, the Product is *Thirds*, and the twelfth Part thereof, is *Seconds*.

So that if you begin to multiply *Parts* by *Feet* in the first Row, and *Parts* by *Inches* in the second Row, and *Parts* by *Parts* in the third Row, the first Figure in every Row will stand a Place more towards the Right Hand; as is to be seen in the last Example.

Example 2. Multiply 37 Feet 7 Inches, 5 Parts, by 4 Feet, 8 Inches, 6 Parts.

F.	I.	P.			
37	7	5			
4	8	6			
150	5	8	S		
12	6	5	8		
12	6	5	8	T	
1	6	9	8	6	
177	1	5	0	6	

First. Multiply by 4 Feet, saying, 4 times 5 is 20, which is 1 Inch 8 Parts; set down 8 and carry 1, saying 4 times 7 is 28, and 1 I carry is 29, which is 2 Feet 5 Inches; set down 5 Inches, and carry 2, saying 4 times 7 is 28, and 2 I carried is 30; set down 0, and carry 3, and say 4 times 3 is 12, and 3 is 15; set down 15.

Then begin with 8 Inches; but because the Feet in the Multiplicand are more than 12, it will be the best Way to work for the Aliquot Parts of 8; so here work for 4 Inches, and set that down twice, 4 being the third Part of 12; therefore take the third Part of 37 Feet, 7 Inches, 5 Parts, which is 12 Feet, 6 Inches, 5 Parts, 8 Seconds: set this down twice.

Then begin with 6 Parts; but instead of multiplying, take half 37 Feet, 7 Inches, 5 Parts (because 6 is half 12) and set it a Place more to the right Hand; thus the half of 37 Feet, is 18; which I must count 18 Inches; because the Multiplier is 6 Parts; so the half of 37 Feet, 7 Inches, 5 Parts, is 1 Foot, 6 Inches, 9 Parts, 8 Seconds, 6 Thirds; which set down, and add all together, and the Sum will be 177 Feet, 1 Inch, 7 Parts, 0 Seconds 6 Thirds.

Example 3. Multiply 34 Feet 4 Inches, 7 Parts, by 36 Feet 7 Inches, 5 Parts.

F.	I.	P.		
311	4	7		
36	7	5		
1866				
933			S.	
103	9	6	4	
77	10	1	9	T.
8	7	9	6	4
2	1	11	4	7
12	0	0	0	0
1	0	0	0	0
	9	0	0	0
11402	2	4	11	11

In this Example, becauſe the Feet in both the Multiplicand and Multiplier are compound Numbers; firſt multiply the Feet one by the other; then take the Aliquot Parts of 7 Inches, which are 4 Inches and 3, that is, a third and a fourth Part; ſo take the third Part of 311 Feet, 4 Inches, 7 Parts, which is 103 Feet, 9 Inches, 6 Parts, 4 Seconds, and the fourth Part is 77 Feet, 10 Inches, 1 Part, 9 Seconds; ſet theſe down one under another, the Feet under the other Feet; then the Aliquot Parts of 5 Parts, are 4 and 1, that is a third and twelfth Part; ſo the third Part of 311 Feet, 4 Inches, 7 Parts, is 103 Feet, 9 Inches, 6 Parts, 4 Seconds; but becauſe the Multiplyer is Parts, it muſt be ſet a Place to the right Hand; that is, the 103 muſt be Inches, which is 8 Feet 7 Inches; therefore I take a fourth Part of 8 Feet 7 Inches; therefore I ſet down 8 Feet, 7 Inches, 9 Parts, 6 Seconds, 4 Thirds.

Then becauſe 1 Inch is a fourth Part of 4 Inches, therefore take a fourth Part of 8 Feet, 7 Inches, 9 Parts, 6 Seconds, 4 Thirds; which is 2 Feet, 1 Inch, 11 Parts, 4 Seconds, 7 Thirds, which is the ſame as if you had taken a twelfth Part of 311 Feet, 4 Inches 7 Parts.

Then for 4 Inches in the Multiplicand, inſtead of multiplying 36 Feet by it, take a third Part, becauſe 4 inches is a third Part of 12; ſo the third Part of 36, is 12 Feet, and the Aliquot Parts of 7 Parts, are 4 and 3, that is a fourth and a third; ſo the third Part of 36 is 12, which now is 12 Inches, that is 1 Foot, and the fourth Part is 9 Inches; add all theſe together, and the Sum will be 11402 Feet, 2 Inches, 4 Parts, 11 Seconds, 11 Thirds.

Example 4. Multiply 8 Feet 4 Inches, 3 Parts, 5 Seconds, 6 Thirds, by 3 Feet, 3 Inches, 7 Parts, 8 Seconds, 2 Thirds.

F.	I.	P.	S.	T				
8	4	3	5	6				
3	3	7	8	2				
25	0	10	4	6				
2	1	0	10	4	6			
	4	10	6	0	2	6		
		5	6	10	3	8	0	
			1	4	8	6	11	0
27	7	3	5	1	8	8	11	0

MUNIONS

MUNIONS [in *Architecture*] are the ſhort, upright Poſts or Bars, which divide the ſeveral Lights in a Window Frame.

MURING is the Walling, or the raiſing of the Walls of a Building.

MUTILATION, is a Term apply'd to Statues and Buildings, where any Part is wanting, or the Projecture of any Member is broke off.

MUTULE [in *Architecture*] is a kind of ſquare Modillion, ſet under the Cornice of the *Doric* Order, and ſo call'd from the Latin Word *Mutulus*, maimed, or imperfect, becauſe they repreſent the Ends of Rafters which are crooked or bent, in like Manner as the Beams or Joints are repreſented by the Triglyphs in the Freeze of the ſame Order.

The only Difference between *Mutule* and *Modillion*, conſiſts in this, that the former is us'd in ſpeaking of the *Dorick* Order, and the latter in that of the *Corinthian*.

MUTULES, M. *LeClerc* makes *Mutules* in the Entablement of the *Doric* Order, to diſtinguiſh it the more from other Entablements; but alſo becauſe they agree very well with the nobleneſs of this Order, and add Something of a Maſculine Beauty to it.

Thoſe who uſe *Mutules*, uſually make them of the ſame Breadth with the Triglyphs, but he thinks it would be much better, if they were made of the ſame Breadth with the Capitals of the Triglyphs.

Nor does he run his *Mutules* ſo near the Extremity of the Larmier or Drip, as is uſually done; but that he leaves a Space of three or four Minutes between the two, that the Profile may appear the more diſtinctly, and he obſerves the ſame Rule in the *Modillions*.

N.

NAILS [in *Building* &c.] are ſmall metalline Members, ſerving to bind or faſten the Parts together.

The ſeveral kinds of Nails are very numerous.

1. *Back* and *bottom Nails*; which are made with flat Shanks to hold faſt, and not open the Wood, being proper for nailing of Boards together for Coolers, for Guts to ſave Water under the Eves of a Houſe, or for any Liquid Veſſels made of Planks or Boards.

2. *Clamp-Nails*; thoſe proper to faſten the Clamps in Buildings, *&c.* and repairing of Ships.

3. *Claſp-Nails*; whoſe Heads claſping and ſticking into the Wood, render the Work ſmooth, ſo as to admit a Plane over it, they are of two Kinds, *viz.* *long*, proper for fine Buildings of Fir and other ſoft Wood, and *ſtrong*, fit for Oak, and other hard Wood; the Sizes are 7, 7½, 8, 10, 13, 15, 18, 21, 22, 23, 28, 32, 36, and 40 *l. per* Thouſand.

Of the *Strong*, the Sizes are 15, 18, 28, 32, 40 *l. per* Thouſand.

4. *Clench Nails* are thoſe commonly us'd by Boat, Lighter- and Barge-Builders, with *Boves*, and often without, they are proper for any boarded Buildings that are to be taken, becauſe they will drive without ſplitting the Wood, and draw without breaking; or admit of punching out, if rightly made. The Sorts are too many to be here enumerated; for fine Work they are made with *Claſp-Heads*.

5. *Clout-Nails*, theſe are ordinarily us'd for nailing on of Clouts to Axle-Trees, but are proper to faſten any Iron to Wood; and if made as they ſhould be, the Heads will hold driving home, without flying.

The Sizes are $4\frac{1}{2}$, 7, 8, 9, 12 and 15 *l. per* 1000.

6. *Deck-Nails*, thoſe are proper for faſtening of Decks in Ships, doubbling of Shipping, and Floors laid with Planks: They are of two Sorts, *Dye-headed*, and *Claſp-headed*.

The Sizes are 4, $4\frac{1}{2}$, 5, $5\frac{1}{4}$, 6, $6\frac{1}{2}$, 7, 8, and 9 Inches long.

7. *Dog-Nails*; proper for faſtening Hinges on Doors, *&c*, if rightly made, they will hold the Hinge cloſe, without the Heads flying off, or without the Help of Botching, by putting Leather between the Head and the Hinge.

The Sizes are 9, 12, 20, 25, 30, 40, 60, 80 and 120 *l. per* Thouſand.

8. *Flat-Points*; are of two Kinds, *viz. Longs*, much us'd in Shipping, and are very proper where there is Occaſion to draw and hold faſt, where there is no Conveniency to clench.

The Sizes are $7\frac{1}{2}$, 8, 9, 10, 11, 12, 13, 14, 16, 18, 21, 22, 23, 26, 40, 55, 75, and 110 *l. per* Thouſand.

The *Short*, theſe are fortified with Points to drive into Oak or other hard Wood, and are often us'd to draw the Sheating Boards to, very proper where Oak or other hard Wood is us'd,

The Sizes are 5, 9, 18, 26, 32, 40, 55, 75, and 110 *l. per* Thouſand.

9. *Jobent Nails*; theſe are commonly us'd to nail thin Plates of Iron to Wood; and to nail on ſmall Hinges for Cupboard Doors, *&c.*

The Sizes are 2 and 3 *l. per* Thouſand.

10. *Lead Nails*; are us'd in nailing Lead, Leather and Canvas to hard Wood.

The Sizes are $4\frac{1}{4}$, 7, and 8 *l. per* Thouſand.

11. *Port Nails*; theſe are commonly us'd in nailing of Hinges to the Ports of Ships.

Theſe Nails ought to be made ſtrong, becauſe they will not admit of being clenched, without prejudicing the Lining; and therefore you muſt take Care to demand them of a juſt Length, that they may come near through (ſo as to take ſufficient Hold) and yet not ſo long as to come quite through.

The Sizes are $2\frac{1}{2}$, 3, 4 and 5 Inches long.

12. *Pound Nails*; theſe are four ſquare in the Shank, much us'd in *Norfolk*, *Suffolk*, and *Eſſex*,

Essex, tho' scarce elsewhere; except for Paleing.

The Sizes are, 6*d.* 8*d.* 10*d.* 20*d.* and 40*d.*

13. *Ribbing Nails*; us'd for fastening the Ribbing, to keep the Ribs of Ships in their Place in Building.

These Nails, if they are rightly made, will hold fast and draw easy, without injuring the Ribbing or Timbers: They are also very useful for fastening of Timbers that are to be us'd for a while and taken down again for further Service.

The Sizes are 5, $5\frac{1}{2}$, 6, $6\frac{1}{2}$, 7, $7\frac{1}{2}$, 8, $8\frac{1}{2}$, and 9 Inches long.

14. *Rose Nails*; these Nails are drawn four Square on the Shank, and commonly in a round Tool, as all common 2*d.* Nails are, and most commonly 3*d.* and 4*d.*

In some Countries they make all their larger Sorts of Nails in this Shape; but their being Square drowneth the Iron, and the Nails do not shew so fair to the Eye, as those that are laid upon the flat, but they are very serviceable if made of tough Iron.

The Sizes are $1\frac{3}{4}$, 2, $2\frac{1}{2}$, $2\frac{3}{4}$, 3, $3\frac{1}{2}$, $3\frac{3}{4}$, 4, $4\frac{1}{4}$, $4\frac{3}{4}$, 5, 9, 10, 13, 14, 16, 17, 18, 24, 26, 28, 30, 32, 36 and 40 *l. per* Thousand.

15. *Rother Nails* are chiefly us'd in fastening Rother Irons to Ships, these Nails require a full Head, and to be made so as to hold fast in the Wood to the greatest Degree, without clenching.

16. *Round-head Nails*; these are very proper to fasten on Hinges, or for any other Use where a neat Head is requir'd; and if they are made of the best tough Iron as they ought to be, are very useful.

The Sorts are Tacks, 2*d.* 3*d.* 4*d.* 5*d.* 6*d.* and 8*d.*

The same are tinn'd for Coffin Handles and fine Hinges.

17. *Scupper Nails*, are much us'd in fastening Leather and Canvas to Wood, and therefore require a broad Head, that neither may work loose.

The Sizes are $4\frac{1}{4}$ 7 and 8 *l. per* Thousand.

18. *Sharp Nails* are much us'd, especially in the *West-Indies*, they are made with sharp Points and flat Shanks, and is a very proper Nail for ordinary Uses where soft Wood is used.

The Sizes are $2\frac{1}{2}$, $2\frac{3}{4}$, 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, 6, $6\frac{1}{2}$, $7\frac{1}{2}$, 8, 9, 10, 11, 12, 13, 14, 15, 18, 19, 20, 21, 22, 33, 28, 32, 36, 40, 55, and 75 *l. per* Thousand.

19. *Sheathing Nails*; these are commonly us'd in fastening Sheathing Boards to Ships: The Rule for using them is to have the Nails full three times as long as the Sheathing Board is thick; provided the Plank be of a sufficient Thickness, which ought to be enquired into; for the Sheathing Nail ought not to go through the Plank by half an Inch, lest it should make the Ship leaky.

The Shank must not be so strong as to cleave the Board, and the Head must be well clapsed or died, so as it may sink into the Wood, and the Ships Side be left smooth.

They

They are alſo a uſeful Nail in doubling of ſmall Ships.

The Sizes are, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}$, $3\frac{1}{4}$ and $3\frac{1}{2}$ Inches long.

20. *Square Nails*; theſe are of the ſame Shape as Sharp Nails, and a moſt uſeful Nail for Oak and other hard Woods, as alſo for nailing up Wall Fruit, the Points being made ſomething ſtronger than the Points of Sharp Nails, which fortifies them to go forward, and not turn back upon a ſmall Oppoſition, as weaker Points will do.

The Sizes are $2\frac{1}{2}$, $2\frac{3}{4}$, 3, 4, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, 6, $6\frac{1}{2}$, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 22, 23, 24, 28, 30, 32, 36, 40, 55, and 75 *l. per* Thouſand.

21. *Tacks*; the ſmalleſt of Nails, are to faſten Paper to Wood; *middling*, for Wool, Cards and Oars, and the *larger* for Upholſters and Pumps.

The Sizes are $2\frac{1}{4}$, 5, 6, 8, 9, 14 and 15 Ounces *per* Thouſand.

Allowance in Lathing]. 500 Nails are ordinarily allow'd to Bundle of five Foot Laths, and 600 to a Bundle of four Foot Laths; at ſix Score Nails to the Hundred.

Allowance in Flooring]. In laying of Floors, 200 (that is 240) is a ſufficient Allowance for a Square of Flooring.

Nails are ſaid to be toughened when too brittle, by heating them in a Fire-Shovel or the like, and putting ſome Tallow or Greaſe among them.

NAKED [in *Architecture*] as the *Naked of a Wall*, &c. is the Surface or Plain from whence the Projectures ariſe, or which ſerves as a Ground to the Projectures.

NAVE [in *Architecture*], the Body of a Church, or the Place where the People are diſpos'd; reaching from the Rail or Balluſter of the Choir, to the chief Door: Some derive it of *Naus i. e.* a Ship, but it ſeems more properly to come from Ναὸς Gr. *Naos* a Temple.

NEWEL [in *Architecture.*] is the upright Poſt which a Pair of winding Stairs turn about; or that Part of a Stair Caſe which ſuſtains the Steps.

The Newel is a Cylinder of Wood or Stone, which bears on the Ground, and is form'd by the Ends of the Steps of the winding Stairs.

There are alſo Newels of Wood, which are Pieces of Wood plac'd perpendicularly, receiving the Tenants of the Steps of the wooden Stairs into their Mortices; and wherein are fitted the Shafts and Reſts of the Stair Caſe, and the Flights of each Story.

NICHES are Hollows ſunk into the Wall, for the commodious and agreeable placing of Statues.

Their ordinary Proportion is to have two Circles in Height and one in width; but M. *Le Clerc* makes their Height ſomething more, the Exceſs being to compenſate for the Height of the Plinth or Pedeſtal of the Statue.

The Hollow is Semi-Circular at Bottom, that is, in its Plan; at Top it terminates in a

a kind of Canopy, or *Cul de four*.

Niches have frequently an Impoſt, and an Archivolte or Head Band, and their Canopy wrought and inrich'd in manner of a Shell.

The Breadth of the Archivolte may be made equal to a ſixth or ſeventh Part of the Niche, and the Height of the Impoſt to be a fifth or ſixth Part of the ſame.

The Impoſt and Archivolt ought to conſiſt of ſuch Mouldings as have ſome Relation to the Architecture of the Place.

When a *Niche* is placed underneath an Impoſt, between two Columns or Pilaſters, it ſhould have no Impoſt of its own; for two Impoſts over each other, would have a woful Effect; beſides that the Pedeſtals in this Caſe, having their Baſes and Corniſhes, there would be too many Mouldings over one another.

There muſt no Niche be made between two Pilaſters, if they are not a-part nearly one third of their Height; otherwiſe we ſhould have Niches too ſcanty and narrow. Care muſt alſo be taken, that they be not too big; leſt by that means the Architecture be made to appear little and pitiful: Thus, for Inſtance from the largeneſs of the Niche one is led to judge that the Architecture is only intended for a Chappel or other Building of an ordinary Size.

Niches ſhould be plac'd at the Height of the Pedeſtal of the Columns or Pilaſters that accompany them.

When Niches are plac'd underneath Impoſts, the opening of the Arches ſhould be ſomewhat narrower than ordinary, that the Impoſts being on that Account a little higher, the Niches may become of a moderate Bigneſs: For this Reaſon, inſtead of 12 Modillions between the Pilaſters, M. *Le Clerc* ſays, I only make 11, that is, I retrench one Modillion from the Corniche, that the Pilaſters may approach each other equally.

When the Columns have no Pedeſtals, a Niche may be rais'd higher than their Baſe; and in that Caſe, a Table or Pannel may be plac'd underneath.

If it happen that a Niche with an Impoſt be plac'd between two Pilaſters, without any Portico, it ſhould be made with a Retreat or Fall backwards, to prevent the Neceſſity of continuing its Impoſt between the Pilaſters. For that Impoſt being proportioned to the Niche, cannot be in Proportion to the Pilaſters. Beſides, without this Expedient, I don't readily ſee how it could be well terminated on the Side of the Gate.

There are ſometimes Niches made ſquare, but theſe want all the Beauty of the others.

If the Order of the Column or Pilaſter ſhould be too big and high, the Niche would become too large and unſizeable, the Pilaſters muſt be brought to a Modillion or two nearer each other, and inſtead of a Niche with a Retreat, a Niche may

may be made with a *Chambranle*, and a Corniche crown'd with a Pediment, over which may be an oval Light of the same width with the Niche.

A *Round Niche* is one whose Plan and Circumference is circular.

Square Niche is one where they are square.

Angular Niche, one that is form'd in the Corner of a Building.

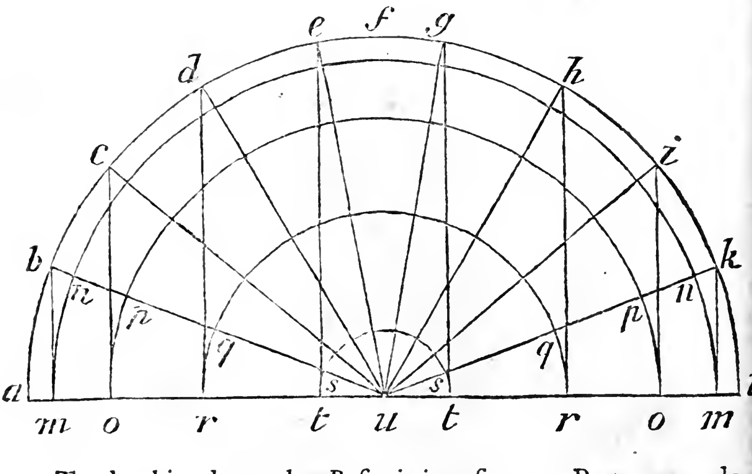
Ground Niche, is one which instead of bearing on a massive, has its Rise from the Ground, as the Niches of the Portico of the *Pantheon* at *Rome*.

Niches are sometimes made with Rustick Work, sometimes with Shell Work, and sometimes of Cradle or Arbour Work.

If the Images be of white Stone or Marble, let not the Concavities be coloured too black, because 'tis an Observation that the Sight is not well pleas'd with sudden Changes from one Extreme to another; therefore let them have rather a dustich Tincture, than an absolute black.

To make a Niche *or* Globe *with thin Boards, or to cover them with Paper or Past-Board.*

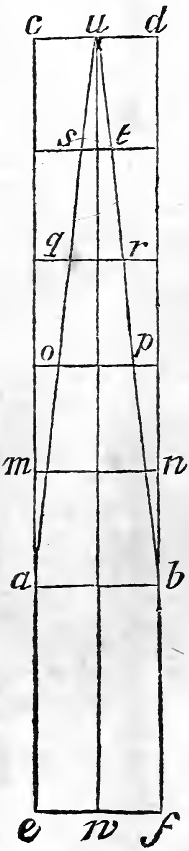
The Arch *a, f, l,* is a Semi-Circle, and the Plan of a *Niche*, and is divided into nine equal Parts mark'd, *a b, b c, c d, d e, e g, g h, h i, i k,* and *k l*; which represents the widest Part of the Board, Paper or Past-Board; and the Figure represents its Shape and the Curve of the Edges before it is bent to its Work.



To do this, draw the Base Line *a l,* to which strike the Semi-Circle *a f l* (and let *a e,* and *f l.* be equal) and divide it into so many Parts as you design the width of Board or Paper in the Quarter of the *Globe* or *Niche*, as in the Example Mark-

Mark, *a b c d e f g h i k l*, and draw the Lines, *b u*, *c u*, *d u*, *e u*, *f u*, *g u*, *h u*, *i u*, and *k u*; alſo the Lines *m b*, *o c*, *r d*, *t e*, *t g*, *r h*, *o i*, and *m k*, perpendicular to the Line *a l*; and ſtrike the Semicircles *m m*, *o o*, *r r*, and *t t*,

Then with a thin Lath, or by Arithmetick take the Length of the Arch or Quadrant *a f*, or *l f*, and ſet it on the Board or Paper from *c d*, to *a b*, in the Second of theſe Figures, which you muſt divide into ſo



many equal Part as there are Semi-Circles in the firſt Figure, which in this Example is 5; and draw the Lines, *c d*, *t s*, *r q*, *o p*, *m n*, and *a b* and divide them in the middle by the Line *u w*:

Then take half the Arch of the *a b* in the firſt Figure in your Compaſſes, and ſet it both Ways from the middle Line *u w* in the ſecond Figure to *a* and *b*; alſo take half the Circles *m n*, *o p*, *r q*, and *t s*, in the firſt Figure, and ſet them on their reſpective Lines on Figure 2, as in the Margin, from the middle Line *u w*, to *m* and *n*, *o* and *p*, *r* and *q*, *t* and *s*. then will the Arch *a b*, be equal to the Right Line *a b*; the Arch *m n*, to the Right Line *m n*; alſo *o p* to *o p*, *r q*, to *r q*, *t s*, to *t s*, and the Point *u* to the Point *u*: The Points *a*, *m*, *o*, *q*, *s*, *u*, *t*, *r*, *p*, *n*, *b*, being found, into each ſtick a a Pin or ſmall Nail, and bend a thin Lath to them, by the Edge of which draw the Curves *a u*, and *b u*, which is the true Mould for every Piece in a Niche or Globe; which is what was to be done.

N. B. This Problem is equally as uſeful for Maſons and Bricklayers, in making Niches in Stone or Brick, as for Joiners, *&c.*

NOTATION [in *Arithmetick*] is the Art of characterizing Numbers, or of deſigning them by proper Figures, the Choice of arithmetical Characters is arbitrary: Hence they are various in various Nations. But perhaps there are none ſo

commodious, as thoſe commonly us'd in *Europe*, which are commonly ſaid to have been invented by the *Arabs*, and thence call'd *Arabick* Characters.

NUCLEUS [in *Architecture*] is the middle Part of the Flooring of the Ancients; conſiſting of Cement, which they put betwixt a Lay or Bed of Pebbles, cemented with Mortar made of Lime and Sand.

NUMBER [in *Arithmetick*] a Collection or Aſſemblage of ſeveral Unites.

Stevinus chuſes to define Number to be that whereby the Quantity of any Thing is expreſs'd. Agreable to which Sir *Iſaac Newton* conceives Number to conſiſt, not in multitude of Unites, as *Euclid* defines it; but in the abſtract Ratio of a Quantity of any Kind, to another Quantity of the ſame Kind, which is accounted as Unity; and on this View he divides Numbers into 3 Kinds, *viz. Integers, Fractions* and *Surds*.

Mathematicians conſidering Number under a great many Circumſtances; different Relations and Accidents make many Kinds of Numbers.

A *determinate* NUMBER, is a Number referr'd to ſome given Unite; as a Ternary or 3, which is what we properly call a Number.

An *indeterminate* NUMBER, that referr'd to Unity in the General, which iswhat we call Unity.

Homogeneal NUMBERS, are thoſe referr'd to the ſame Unite.

Heterogeneal NUMBERS are thoſe referr'd to different ones.

Whole NUMBERS, or *Integers*, are the Aſſemblages of *Unity*, or the Idea we have of a Multitude.

Broken NUMBERS or *Fractions*, are thoſe which conſiſt of ſeveral Parts of Unity.

Rational NUMBER, is one that is commenſurable with Unity.

Rational whole NUMBER, is that whereof Unity is an Aliquot Part.

Rational broken NUMBER, is that equal to ſome Aliquot Part, or Parts of Unity.

Rational mix'd NUMBER, is that which conſiſts of a whole *Number* and a broken one, or of Unity and a Fraction.

Irrational NUMBER or *Surd*, is a Number that is incommenſurable with Unity.

Even NUMBER, is that which may be divided into two equal Parts, or without Remainder or Fraction, as 4, 6, 8, 10, *&c.*

An *Evenly even* NUMBER, is one that may be meaſured or divided, without any Remainder, by another even Number.

Unevenly even NUMBER, is a Number that may be equally divided by an uneven Number, as 20 may be divided by 5.

Uneven NUMBER, is that which exceeds an even Number, at leaſt by Unity, or which cannot be divided into two equal Parts.

Primitive or *Prime* NUMBER, is that which is only diviſible by Unity, as 5, 7, 11, *&c.*

Prime

Prime NUMBERS *among themselves*, are those which have no common Measure, as 12 and 19.

Compound NUMBER, is one that is divisible by some other Number besides Unity, as 8 is divisible by 4 and by 2.

Compound NUMBERS *among themselves*, those which have some common Measure besides Unity, as 12 and 15.

Perfect NUMBER, is that whose Aliquot Parts added together, make the whole Number, as 6, 28, &c. the Aliquot Part of 6, being, 3, 2, and 1, = 6, and those of 28, being 14, 7, 4, 2, 1, which together make 28.

Imperfect NUMBERS, are those whose Aliquot Parts added together, make either more or less than the whole of which they are Parts.

Imperfect Numbers are distinguish'd into *abundant* and *defective*.

Abundamt NUMBERS, are those whose Aliquot Parts, make more than the Number of which they are Parts, as 12, whose Aliquot Parts, 8, 4, 2 and 1, makes 16.

Defective NUMBERS, are those whose Aliquot Parts added together, make less than the Number whose Parts they are; as 16, whose Aliquot Parts are 8, 4, 2 and 1 only make 15.

Plane NUMBER, is one that arises from the Multiplication of two Numbers; *ex. gr.* 6 which is the Product of 3 multiply'd by 2; the Numbers which are thus multiply'd produce a *plane Number*, as here 2 and 6 are call'd the Sides of the *Plane*.

Square NUMBER, is the Product of any Number multiply'd by it self; Thus 4 the *Factum* of 2 by 2 is a square Number.

Every square Number added to its Root, makes an even Number.

Cubick NUMBER, is the Product of a *Square Number* multiply'd by its Root, *ex. gr.* 8 the Product of the Square Number 4, multiply'd by its Root 2.

Polygonous NUMBERS are the Sums of Arithmetical Progressions, beginning with Unity.

These where the Difference of Terms is 1. are call'd *Triangular Numbers*; where 2, *Square Numbers*; where 3, *Pentagonal Numbers*; where 4, *Hexagonal Numbers*; where 5, *Heptagonal Numbers*, &c.

Pyramidal NUMBERS, the Sums of *Polygonous Numbers*, collected after the same Manner as the *Polygons* themselves, are gathered out of Arithmetical Progressions, and are call'd *first Pyramidal Numbers*.

The Sums of the *first Pyramidals* are call'd *second Pyramidals*, the Sums of the *Second Pyramidals* are call'd *Third Pyramidals*.

In particular they are call'd *Triangular Pyramidal Numbers*, if they arise out of Triangular Numbers *First Pentagonal Numbers*, if they arise out of *Pentagons*, &c.

Cardinal NUMBERS are

those which express the Quantity of Unites as 1. 2. &c.

Ordinal NUMBERS, are those which express the Order or Rank, as 1*st*, 2*d*, 3*d*, &c.

NUMERATION, [in *Arithmetick*] the Art of valuing pronouncing, or reading any Number, or Series of Numbers.

The Characters by which Numbers are usually express'd, are the nine following ones, *viz.* 1, 2, 3, 4, 5, 6, 7, 8, 9. It being the Law of the common *Numeration*, that when you are arriv'd at ten, you begin again and repeat as before, only expressing the Number of tens.

That the nine numerical Notes may express not only Units, but also Tens or Decades, Hundreds or Centuries, Thousands, &c. They have a Local Value given them, so as that when either alone, or when plac'd in the Right Hand Place, they denote Units; in the second Place Tens; in the third Place, Hundreds, in the fourth, Thousands, &c.

NUMERATOR *of a Fraction*, is that Part of it which shews or numbers how many of those Parts which any Integer is suppos'd to be divided into, are express'd by the Fraction.

Thus in $\frac{6}{8}$ 6 is the Numerator (which stands always above the Line) and shews you, that if any whole be divided into eight Parts, you number and enumerate or take six of them, *i. e.* three Quarters.

O.

OAK, a Sort of Timber well known. It is one of the principal Materials in Building, being strong in all Positions, and may well be trusted in cross and transverse Work; as for Summers and Girding, or binding Beams, &c.

Of sawing Oak.] It is worth sawing 2*s.* 8*d. per* Hundred, 3*s.* and upwards to 3*s.* 6*d. per* Hundred, that is, a hundred superficial Feet.

OBELISK is a Quadrangular Pyramid, very high and slender, rais'd as an Ornament in some publick Place to shew the largeness of some Stone of an enormous Size, or to serve as a Monument of some memorable Transaction, and frequently charg'd with Inscriptions and Hieroglyphicks.

Some make this Distinction between *Obelisks* and *Pyramids*; that an *Obelisk* has a very small Base, and a *Pyramid* a large one.

Cardan makes the Difference to consist in this, that an *Obelisk* is to be all of a Piece, or consist of a single Stone and *Pyramids* of several.

The Proportions in the Height and Thickness, are nearly the same in all *Obelisks*, that is, their Height is nine or nine and a half, and sometimes ten times their Thickness, and their Thickness or Diameter at the Top is never less than half, and never greater than three fourth of that at the Bottom.

It

It appears that this Kind of Monument was very ancient, and some say, they were first us'd for transmitting to Posterity the principal Precepts of Philosophy, which were engraven on them in Hieroglyphical Characters. The first *Obelisk*, History gives us Account of, was rais'd by *Ramises* King of *Egypt*, in the Time of the Trojan War. It was 40 Cubits in Height, and as *Herodotus* relates, employ'd 20000 Men in the Building.

Another of 45 high, was rais'd by *Phius* another King of *Egypt*, and another of 88 Cubits, was erected in Memory of *Arsinoe*, by *Ptolemy Philadelphus*.

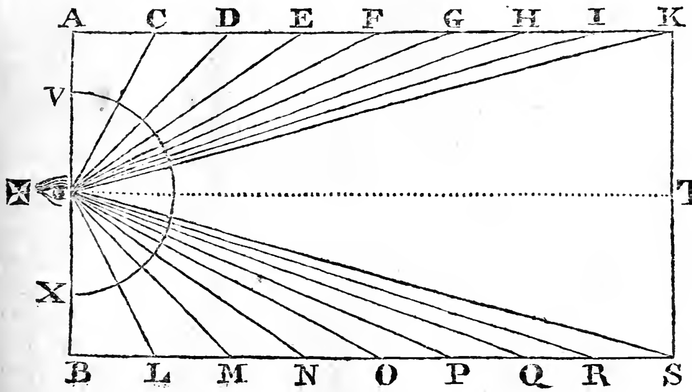
There was an *Obelisk* erect- in the *Campus Martius* at *Rome* by *Augustus Cæsar*, which serv'd to mark the Hours on a horizontal Dial, drawn on the Pavement.

F. *Kircher* reckons up 14 *Obelisks* that were celebrated above the Rest, *viz.* that of *Alexandria*; that of the *Barberins*; those of *Constantinople*; of the *Mons Esquilinus*; of the *Campus Flaminius*; of *Florence*; of *Heliopolis*; of *Ludovisco*; of S. *Makut*; of the *Medici*, of the *Vatican*: of M. *Cælius*, and that of *Pamphila*.

Obelisks were called the Sun's Fingers by the *Egyptian Priests*, because they were made to serve as *Styles*, or Gnomons to mark the Hours on the Ground. The *Arabs* still call them *Pharaoh's Needles*, whence the *Italians* call them *Aguglia*, and the *French Aiguillies*.

OBJECTS [in *Perspective*] It is shewn by the following Figure why Objects appear the nearer each other, as they are more remote from the Eye.

Suppose a Spectators Eye in the middle of a Line at + it is evident, that if it would see the two Extremes thereof, A and B, it must take in a Semi-Circle V X, whose Centre is in the Eye it self, and whose central Ray, is the Line +T.



By taking in this Semi-Circle, it will receive the Objects on either Side, and in such Manner, as that those furthest off from the Side A, appear to approach towards the Centre T, and those on the Side B, seem to approach likewise.

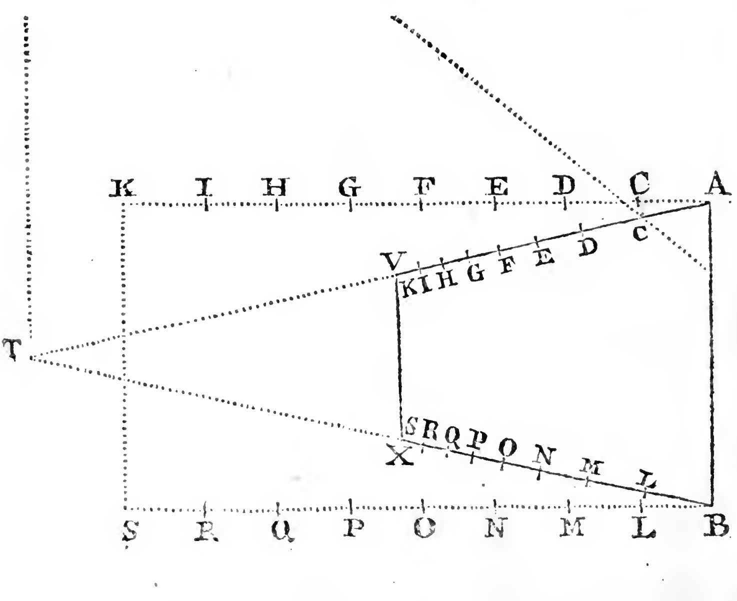
Now if it be ask'd, How Things so wide asunder, should come to approach and join each other, and that, whether situated Side-wise, or over one another?

The Answer in few Words, is this: All Objects appear under the visual Angle, they subtend at the Eye. Now be they Columns, Trees, Animals or any other Things, plac'd on the Side of A, the Remotest will seem to border on the Centre T, by Reason that they are seen under an Angle or Ray that is near thereto.

The Ray + K for Instance, being much nearer the Central Ray T, than is the Ray + C and + E, and of Consequence must appear to be there: Add that if the Objects were prolonged to Infinity, they would still approach nearer to the Central Ray T. till such Time as they seem contiguous therewith, and only to form one Point together.

Now in Perspective, the Sides A K and B S don't continue parallel, but degenerate into visual Rays, intersecting each other in the Point of Sight, and by that means giving the Diminution of Objects.

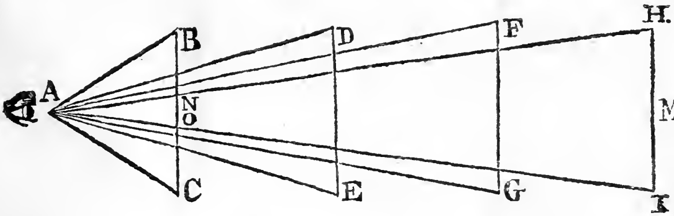
Thus for Instance, in this Figure, the Eye being at a Distance capable of seeing the Line A B, from the two Angles A B arise two Rays, which proceed to the Point of Sight T, which Rays A T and B T receive the Intersections, the Point of Distance makes with the Objects, which all the



while contract themſelves proportionably. By ſuch Means, the whole Parallelogram A K B S, and all the Objects on either Side become reduc'd into the narrow Compaſs A V B X; and if the Eye were more remote, that Space would be ſtill ſmaller; ſince the farther an Object is off, the ſmaller it appears, as will appear by the following Figure.

The Reaſon why Objects appear the ſmaller, as they are at the greater Diſtance.

It has been ſhewn before that Things appear according to the Angle wherein they are ſeen, and that this Angle is taken at the Eye, where the Lines terminating the Objects meet.



The Eye A for Inſtance, viewing the Object B C, will draw the Rays A B and A C, which give the Angle B A C; ſo that an Object view'd under a greater Angle, will appear large, and another under a leſſer Angle, little.

Now 'tis certain, that among equal Objects, thoſe at the greateſt Diſtance, will appear under the ſmalleſt Angle; conſequently in all Perſpectives, the remoteſt Objects muſt be made the ſmalleſt.

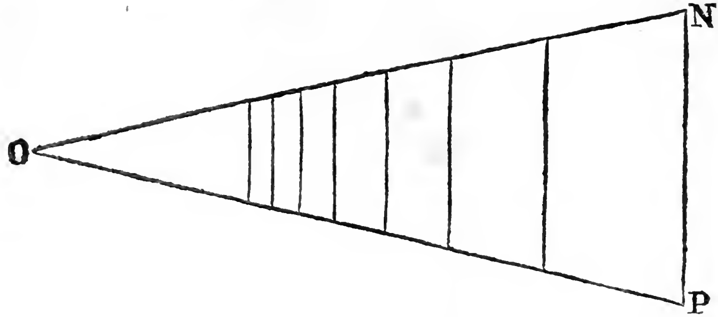
As for Example, if the Eye be in A, the Object B C, which is the neareſt, will appear the biggeſt, becauſe being ſeen under the greateſt Angle; and the ſecond, third fourth Objects, will all appear ſmaller and ſmaller, tho' really all equal, in as much as the Angles diminiſh in Proportion as the Objects recede.

If the Eye were remov'd into M K L, would appear the largeſt; and B C in this latter Caſe, no bigger than N O.

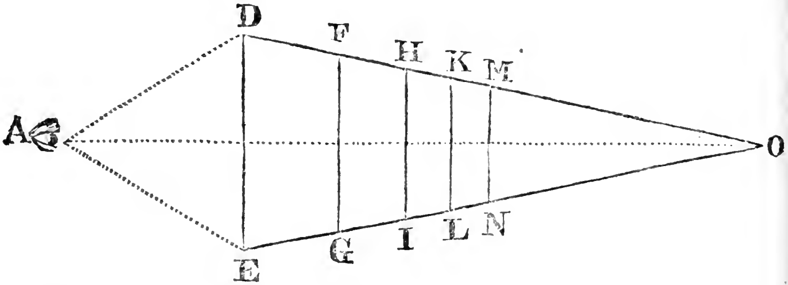
The Second Figure is the Sequel of what has been advanc'd.

For ſuppoſing the Objects to appear ſuch as is the Angle they are ſeen in, it follows that if ſeveral Lines be drawn between the Sides of the ſame Triangle, they will all appear equal: Thus all the Lines compriz'd between the Sides O N O P of the Triangle N O P, will appear equal to each other; and as Objects comprehended under the ſame Angle, ſeem equal, ſo all comprehended under a greater Angle ſeem greater, and all under a ſmaller Angle, ſmaller.

Thus



Thus much being ſuppos'd; if there be a Number of Columns or Pilaſters to be rang'd in Perſpective on each Side of a Hall or Church, they muſt of Neceſſity be all made under the ſame Angle, and all tend towards one common Point in the Horizon O.



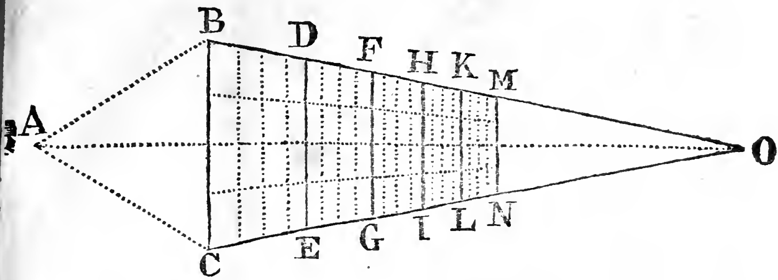
For Inſtance, the Eye being plac'd in A, viewing the firſt Object D E; if from the Poin s D E you draw the viſual Rays D O, E O, they will make the Triangle D O E, which will include the Columns D E, F G, H I, K L, M N, ſo as they will all appear equal.

What has been ſaid of the Sides is likewiſe to be underſtood of Ceilings and Pavements; the Diminutions of the Angles of remote Objects, plac'd either above or below, following the ſame Rule as thoſe plac'd laterally.

Therefore there is no need of adding any thing farther; unleſs it be, that Care be taken that there be as many Squares or Diviſions between the remoteſt Objects, as between the neareſt: for in that Caſe, tho' diſtant Objects be the cloſer, as they are further from us, they will appear in ſome Meaſure to preſerve their Diſtance; thus in B C D E, the Interval between the four neareſt Columns, there are 16 Squares; and no fewer between the two moſt remoteſt K M.

It follows from what has been ſaid, that if you join two Triangles, as in the laſt Figure but

one



one for the Sides, and two others of the laſt, for Tops and Bottoms of an Object, all four will terminate in one ſingle Point A, which is the Point of Sight where all viſual Rays meet; and this will demonſtrate what has been advanc'd, *viz.* that Objects diminiſh as they remove, the lower riſing, the upper falling, and the lateral cloſing or approaching: an Example of all which is given in Figure 1, which exhibits as it were, Depths and Diſtances, falling back and receeding from us, though all equally near the Eye.

Trees being rang'd by the ſame Law, have the ſame Effect as the Columns, *&c.*

For being all comprehended in the ſame Angle, and the two Rows having each its own Angle, and the Angles all meeting in the Point A, they form a third, which is the Earth and a fourth, which if you pleaſe is the Air.

OBLIQUATION [in *Catoptricks*] as the Cathetus of Obliquation is a Right Line drawn perpendicular to a Mirrour in the Point of Incidence or Reflexion of a Ray.

OBLIQUE [in *Geometry*] aſlant, Indirect, or which deviates from the Perpendicular.

OBLIQUE *Angle* [in *Geometry*] is an Angle that is either acute or obtuſe: *i. e.* any Angle, except a Right Angle.

OBLIQUE *angled Triangle*, is that whoſe Angles are oblique, *i. e.* either obtuſe or acute.

OBLIQUE *Line*, a Line falling on another, makes an oblique Angle.

OBLIQUE *Projection* [in *Mechanicks*] is that where a Body is impell'd in a Line of Direction, which makes an oblique Angle with the horizontal Line.

OBLIQUE Force [in *Mechanicks*] is that whoſe Line of Direction is not at Right Angles with the Body on whom it is impreſt. The Ratio which ſuch an *oblique Force* to move a Body bears to a direct or Perpendicular Force, will be as the Line of the Angle of Incidence is to the Radius.

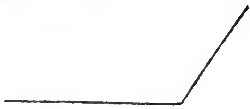
OBLIQUITY is that which denominates a Thing oblique, as the Obliquity of the Sphere.

OBLONG [in *Geometry*] is the ſame with a Rectangled Parallelogram, whoſe Sides are unequal; or it is a Figure longer

longer than it is broad; thus a Rectangle or Parallelogram is an oblong; and an Ellipsis in an Oblong.

OBTUSE, literally signifies blunt, dull; in Opposition to acute, sharp.

OBTUSE *Angle* [in *Geometry*] is an Angle of more than 90 Degrees, *i.e.* more than a Quadrant of a Circle; or it is an Angle greater than a Right Angle.

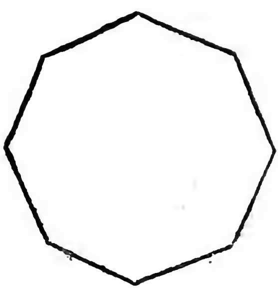


OBTUSE *angled Triangle* is one that hath an obtuse Angle, as above.

OCCULT [in *Geometry*] is us'd in speaking of a Line that is scarce perceiveable, drawn with the Point of the Compasses or a black Lead Pencil.

Occult or dry Lines are us'd on several Operations, as the raising of Plans, Designs of Building, Pieces of Perspective &c. they are to be effaced when the Work is finish'd.

OCTAGON [in *Geometry*] is a Figure of eight Sides and Angles; or it is one of the five Regular Bodies, consisting of eight equal Faces, or eight equilateral Triangles. It is call'd a *regular Octagon,* when all the Sides and Angles are equal, and is such as may be inscrib'd in a Circle.

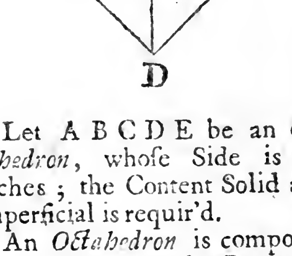


Every *Regular Octagon* is a mean Proportional between the circumscribing and the inscrib'd Square.

OCTAHEDRON } [in *Geometry*]
OCTAEDRON }
is one of the Regular Solids, consisting of eight equal and equilateral Triangles.

The Square of the Side of the *Octahedron* is to the Square of the Diameter of the circumscribing Sphere, as 1 to 2 or is in a Subduple Ratio of the Diameter of the circumscribing Sphere.

If the Diameter of the Sphere be 2. the Solidity of the *Octahedron* inscrib'd to it, will be 1 . 33333.



Let A B C D E be an *Octahedron*, whose Side is 12 Inches; the Content Solid and Superficial is requir'd.

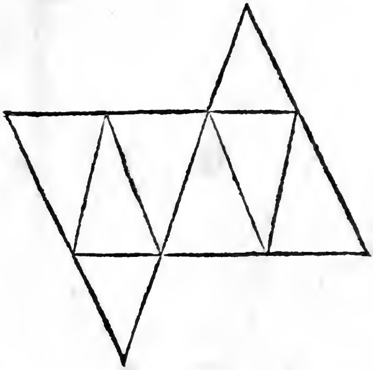
An *Octahedron* is compos'd of two Quadrangular Pyramids join'd together by their Bases, as in the second Figure; therefore

fore if the Area of the Baſe be multiply'd into a third Part of the Length of both Pyramids, the Product will be the Solid Content.

```
     5.6568
        144
     ------
     226272
    226272
   56568
   --------
   814.5792
```

The Superficial Content will be juſt double to that of the *Tetrahedron*, *viz.* 498.816; becauſe the Side of this is ſuppos'd to be equal to the Side of that; and becauſe the *Octahedron* is contain'd under 8 Triangles and the *Tetrahedron* but under 4.

By this Figure you may cut this Body in fine Paſte-board, cutting all the Lines half through. and ſo turn it up and glue it.



OCTOSTYLE [in *Architecture*] is the Face of an Edifice adorn'd with 8 Columns.

OFFICES [in *Architecture*] are all the Lodges and Apartments, which are employ'd for the neceſſary Services and Occaſions of a Palace or great Houſe; eſpecially thoſe which have Relation to Eating; as, Kitchins, Pantries, Bake-Houſes, Brew-Houſes, Granaries, Fruiteries, Confectionaries, Wood-Houſes, Equerries, &c.

The Offices are commonly in the Baſſe Courts; and ſometimes they are ſunk under Ground, and well vaulted, &c.

OGEE, O. G, OGIVE [in *Architecture*] is a Moulding conſiſting of 2 Members, the one Concave and the other Convex, or of a round and a hollow, like an S, the ſame with *Cymatium*.

Vitruvius makes each Member a Quadrant of a Circle. *Scammozzi* and ſome Others, make them ſomewhat flatter, and ſtrike them from two equilateral Triangles.

OGIVE [in *Architecture*] Is us'd for an Arch or a Branch of a *Gothick* Vault, which inſtead

ſtead of being circular, paſſes diagonally from one Angle to another, and forms a Croſs between the other Arches, which makes the Sides of the Square, of which the Arches are Diagonals.

The middle where the *Ogives* cut or croſs each other, is call'd the Key; which is ſometimes cut in form of a Roſe, or a *Cul de Lamp*.

The Members or Mouldings of the *Ogives* are call'd Nerves, Branches, or Reins; and the Arches which ſeparate the *Ogives*, double Arches.

OIL: To make a drying Oil to make any Colour that is mixt with it, dry quickly,

Add two Ounces of Litharge of Lead (to be had at the Druggiſts) to a Quart of Linſeed Oil (tho' ſome uſe Red Lead) powdered very fine, and boil it for near an Hour in an earthen Pan, or till the Oil be grown fat, or almoſt of the Conſiſtence of Treacle, then ſet it on Fire with a lighted Paper, keep it ſtirring while burning, which need not be above a Minute or two, then put out the Flame, and let it ſtand till it be thoroughly cold, and that the Litharge has ſettled well to the Bottom; then pour off the clear Oil, and put it in a Bladder, cloſe ty'd up for Uſe.

When you mix up your Colours for working, take three Parts of plain Linſeed Oil, and one Part of this drying Oil and mixing them well together, temper up your Colours with this Mixture.

This fat drying Oil ſhall not only make the Colours dry ſooner; but will alſo add a Beauty and Luſtre to the Colours.

Some Colours indeed don't need to have their Drying haſten'd by a fat Oil, as Red-Lead, Verdigreaſe and Umber, they being very drying of their own Nature; but yet fat Oil added to thoſe alſo, add a great Beauty and Luſtre to their Colour.

Some Painters to make their Colour dry, take *Copperas*, and having beaten it to Powder, burn it in a Fire-Shovel; as People do when they burn Allum, that is, they ſet it on a Fire, till being melted with the Heat, it be continued thereon ſo long, till all the Moiſture be exhaled, and the Matter remain a dry white Calx; ſome of this Powder of burnt *Copperas* being added to the Colours in Grinding, will make the Colour dry very well.

There is indeed one Inconvenience in the drying Oil above-mentioned, which is, that it makes the Oil of a deep reddiſh Colour, which is apt to alter the native Beauty of ſome Colours, as Whites, making them turn Yellow, and blues become Greeniſh.

But a drying Oil may be prepar'd, which ſhall be of a clear white Colour, as follows.

Put two Ounces of Litharge to a Quart of Linſeed Oil, put the Mixture into a Glaſs, and ſet it in the hot Sun for a Month in the Summer time; ſtirring the

the Litharge and the Oil well together twice a Week during the whole Time; and you will not fail in that time to have not only an Oil very white and clear (for the Sun takes away all Colour either from Linſeed or Walnut Oil) but alſo it will become in that Time very fat and thick, and attain a very drying Quality.

By the ſame Methods may Nut Oil be made to dry, as well as that of Linſeed, it being preferr'd before that of Linſeed, for all white Painting that is not expos'd to the open Air, for 'tis obſerv'd, that in all cloſe Places, Linſeed Oil is apt to make white Lead turn yellow.

You muſt take Notice that all ſimple Colours us'd in Houſe Painting, appear much more beautiful and luſtrous when they appear as if glaz'd over with a Varniſh, to which both the drying Oil mentioned before, contributes very much, and alſo the Oil of Turpentine, that Painters uſe to make their Colours dry ſoon.

But Experience has taught, that ſome good clear Turpentine, diſſolv'd in the 'foreſaid Oil of Turpentine, before it be mix'd with the Oil Colours, will make thoſe Colours ſhine much when dry, and preſerve their Beauty beyond moſt other Things, drying with an extreme Gloſſy Surface, more ſmooth than Oil alone, and will alſo better reſiſt the Injuries of the Air and Weather, provided too much of it be not put in.

OMPHALOPTICK [in *Opticks*] is a Glaſs that is convex uſually call'd a *Convex Lens*.

OPPOSITION [in *Geometry*] is the Relation of two Things between which a Line may be drawn Perpendicular.

OPTICKS is properly the Science of direct Viſion; tho' the Word is ſometimes us'd in a larger Senſe, for the Science of Viſion or Viſibles in general; and in this Senſe it includes *Catoptricks*, *Dioptricks*, and even *Perſpective*.

Opticks is a mathematical Science that treats of the *Sight* in general, and of every thing which is ſeen with direct Rays; and explains the ſeveral Properties and Effects of Viſion in general, and properly of that which is direct and ordinary; for when the Rays of Light are conſidered as *reflected*, the Science which teaches their Laws and Properties is call'd *Catoptricks*; and when the *Refraction* of Rays is conſider'd, and the Laws and Nature of it explain'd and demonſtrated, the Science is call'd *Dioptricks*; or

Opticks in its extenſive Signification may be conſider'd as a mixt mathematical Science, explaining the Manner wherein Viſion is perform'd in the Eye; treats of the Sight in the general; gives the Reaſon of the ſeveral Modifications or Alterations which the Rays of Light undergo in the Eye, and why Objects appear ſometimes bigger and ſometimes ſmaller, ſometimes more diſtinct, ſometimes more confus'd, ſometimes

nearer and sometimes farther off.

In this extensive Signification it is consider'd by Sir *Isaac Newton* in his admirable Work call'd *Opticks*; from *Opticks* likewise arises *Perspective*; all the Rules of which have their Reason or Foundation in *Opticks*; and though *Tacquet* makes *Perspective* a Part of *Opticks*, yet *John* Archbishop of *Canterbury*, calls *Opticks*, *Catoptricks* and *Dioptricks*, by the Name of *Perspective*.

OPTICK *Pencil* or Pencil of Rays, is that Assemblage of Rays, by Means whereof any Point or Part of an Object is seen.

OPTICK *Pyramid* [in *Perspective*] is a Pyramid, whose Base is the visible Object, and its Vertex in the Eye; form'd by Rays drawn from the several Points of the Perimeter.

OPTICK *Rays* are particularly us'd for those wherewith an *Optick Pyramid* or *Optick Triangle* is terminated, as

OPTICK *Axis*, is a Ray passing through the Centre or the middle of the *Optick Pyramid*.

OPTICK *Chamber*; or call'd CAMERA OBSCURA, is the Name of an Optick Machine; wherein (the Light only coming through a double Convex Glass) Objects expos'd to broad Day-Light, and opposite to the Glass, are represented inverted upon any white Matter placed within the Machine in the Focus of the Glass.

The Representations of Objects in this Machine are wonderfully pleasant, not only because they appear in their just Proportions, and are endued with all the natural Colour of their Objects; but likewise shew their various Motions, which no Art can imitate; and a skilful Painter by the Assistance of one of these Machines, may observe many Things from the Contemplation of the Appearance of Objects therein, which will be an Help to the Perfection of the Art of *Painting*, and even a Bungler may accurately enough delineate Objects by Means of it.

Mr. *Gravesend* at the End of his Perspective has given the Description and Use of two Machines of this Kind, which are the best that have yet been made, especially the former.

OPTICK *Glasses*, are Glasses that are ground either Concave or Convex, so as either to collect or disperse the Rays of Light; by Means of which, Vision is improv'd, and the Eye strengthened, preserv'd, *&c.*

ORATORY [in *Architecture*] is a Closet or little Apartment in a large House near a Bed Chamber, furnish'd with a little Altar, or an Image for private Devotion (among the *Romanists*).

The ancient Oratories were little Chappels adjoining to Monasteries, where the Monks said their Prayers before they had Churches.

ORDER [in *Architecture*] is a System of the several Members,

Members, Ornaments and Proportions of Columns and Pilasters; or it is a regular Arrangement of the projecting Parts of a Building, especially those of a Column; so as to form one beautiful whole: Or *Order* is a certain Rule for the Proportions of Columns, and for the Figures which some of the Parts ought to have, on the Account of the Proportions that are given them.

M. *Le Clerc* defines an *Order* to be a Column charg'd with an *Entablature*, and supported on a Pedestal.

The Origin of Orders may be said to be almost as ancient as human Society: the Rigour of the Seasons first put Men upon making little Cabins to retire into; at the first they were made half under Ground, and half above, and were covered with Stubble. But in Time growing more expert, they laid Trunks of Trees an End, and laid others a-cross to bear up the Covering.

From hence they took the Hint of more regular Architecture; the Trunks of Trees upright, representing Columns; and the Girds or Bands which serv'd to keep the Trunks from bursting, express'd Bases and Capitals; and the Summers which lay a-cross, gave the Hint of Entablatures; and likewise did the Coverings ending in Points, give a Notion of Pediments. This Hypothesis we have from *Vitruvius*, and it has been well illustrated by M. *Blondel*.

Others are of the Opinion that Columns took their Rise from the Pyramids which were erected by the Ancients over Tombs; and that the Urns wherein their Ashes were inclos'd, represented the Capitals, the *Abacus* of which was a Brick laid over to cover the Urn: But *Vitruvius*'s Account seems the most natural.

In time, the Height of Columns were regulated by the *Greeks* on the Foot of the Proportion of a human Body. The *Doric* represented a Man of a strong, robust make; the *Ionic* that of a Woman, and the *Corinthian* that of a Girl; Their Bases and Capitals were their Shoes, Head Dress, &c.

The three *Greek* Orders represent three different Manners of Building, *viz.* the *solid*, *mean*, and *delicate*; the two *Italian* ones, are imperfect Productions of these.

The little Regard the *Romans* had for these last, appears from this, that we meet not with one Instance in the *Antique* where they are intermixt.

Daviler observes, that the Abuse the Moderns have introduc'd by the Mixture of the *Greek* and *Latin* Orders, arises from their Want of Reflection on the Use which the Ancients made thereof.

The Definitions *Vitruvius*, *Barbaro*, and *Scamozzi*, have given of Orders, are so obscure, that it is not worth while to spend Time in repeating them; it is sufficient to observe, that there are five *Orders* of Columns; three of which are *Greek*, *viz.* the *Doric*, *Ionic*, and

and *Corinthian*; and two *Italian*, *viz.* the *Tuscan* and *Composite*.

To give a general Idea of the *Orders*, it will be necessary to observe, that the whole is compos'd of two Parts at least, *viz.* the Column and the Entablature, and of four Parts; at the most; where there is a *Pedestal* under the Columns; and one *Acroter* or little Pedestal on the Top of the Entablature.

That the *Column* has three Parts, *viz.* the *Base*, the *Shaft* and the *Capital*; the *Entablature* has three likewise, *viz.* the *Architrave*, the *Frize* and the *Cornice*; which Parts are all different in the several Orders, having each their particular Characters and Members, call'd by the general Names of *Mouldings or Ornaments*.

These Orders took their Names from the People among whom they were invented. *Scammozzi* calls the *Tuscan* the *Gigantick*; the *Doric*, the *Herculean*; the *Ionic*, the *Matronal*; the *Composite*, the *Heroick*, and the *Corinthian* the *Virginal*.

I shall here present you with what M. *Le Clerc* gives us, relating to the Orders.

An Order of Columns is usually understood of a Column bearing its Entablature; but the Order is scarcely compleat except the Column be rais'd on a Pedestal.

The Pedestal, Column and Entablement, are three Compound Parts, each consisting of three Others, as has been said before.

The Ancients have given us five several Orders of Columns, the *Tuscan*, *Doric*, *Ionic*, *Roman* and *Corinthian*.

The *Tuscan* ORTER is the first, most simple and solid, its Column is seven Diameters high, and its Capital, Base and Entablature, have but few Mouldings for Ornaments.

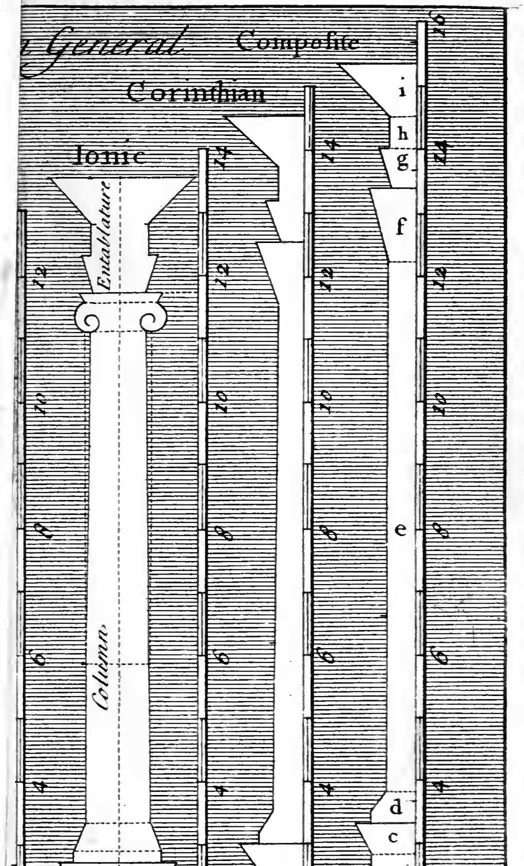
If we give Credit to M. *de Cambray* in his Parallel, this Order ought never to be us'd any where but in Rusticks, or Country Houses and Places.

And indeed, in the Manner that *Vitruvius*, *Palladio*, and some others describe it, it scarce deserves to be us'd at all.

Methinks however in *Vignola*'s Manner of Composition, it has certain Beauties in its Simplicity, which add a Value to it, and render it worthy to be us'd, not only in private Houses, but also in publick Buildings; as in Porticoes of Markets; of publick Halls; in Magazines or Granaries of Cities; and even in Palaces and Seats of Princes and Noblemen, particularly in the lower Apartments, Offices, Stables, (not Equerries as is translated there) &c.

And in general, in all Places, where Strength and Simplicity are required, and where any of the richer and more delicate Orders would be unsuitable.

The *Doric* ORDER is the Second, and most agreeable to *Nature*. It is the most ancient, and given us by the *Greeks*; It has no Ornament on its Base, or on its Capital. Its Height is


General
Composite
Corinthian
Ionic
Entablature
Column
Pedestal
a
b
c
d
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f
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h
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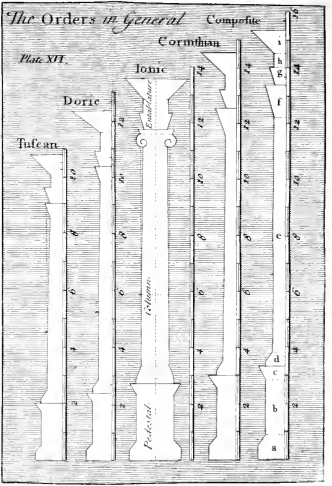
6
8
10
12
14
16


The Orders in General
Plate XII.
Tuscan
Doric
Ionic
Corinthian
Composite
Entablature
Column
Pedestal
a
b
c
d
e
f
g
h
i
2
4
6
8
10
12
14
16

is eight Diameters. Its Frieze is distinguish'd by Triglyphs and Metopes.

Its Composition is grand and noble, and the Triglyphs which make the Ornaments of its Frieze, bearing some Resemblance to a Lyre, seems to intimate it to have been originally intended for some Temple consecrated to *Apollo*.

As we are now furnish'd with richer and more delicate Ornaments, the *Doric* is most properly us'd in the Gates of Cities, in Arsenals and Places of Arms; in Halls of Guards, and other Buildings, which have Relation to War; where Strength and a rough, but noble Simplicity, are particularly requir'd.

In the most ancient Monuments of this *Order*, the Columns are without Bases, the Reason of which is not easy to assign.

M. *de Cambray* in his *Parallel*, is of the same Opinion with *Vitruvius*, that the *Doric* Column, not the *Ionic*, (as the Translator of *Le Clerc* has it) having been compos'd in Imitation of a naked Man, nervous and robust, as an Hercules, it ought to have no Base; imagining a Base to be that to a Column, which a Shoe is to a Man. But for my own Part, I must confess, I can't consider a Column without a Base, but in comparing it to a Man; I rather form the Idea of a Man without Feet, than without Shoes.

For this Reason, I am rather of Opinion, either that the ancient Architects had not yet thought of adding Bases to their Columns, or that they declin'd, on Purpose, to give them any, with design to keep the Pavement clear, and unembarrass'd with the Angles and Projectures of Bases, which are apt to occasion People passing by to stumble.

This also appears the more probable, in Regard that the Architects of those Times us'd to range their Columns exceedingly near one another; so that if they had been furnish'd with Bases, the Passages between, would have been extremely narrow and incommodious.

And this appears to be the Reason, why *Vitruvius* orders the Plinth of the *Tuscan* Column to be rounded off; that Order in the Manner he describes it, being particularly adapted to the servile Offices of Business, and Commerce, where Conveniency is always to be consulted before Beauty.

Be this as it will, every Man of a good Taste will allow, that a Base adds a Grace to a Column, and that it is a very necessary Appendage, in Regard it makes it stand the more firmly on its Plan: so that if no Columns are made now without Bases, this ought not to be imputed to the Prejudices of our Architects, as some Admirers of Antiquity will have it; but to their Prudence.

The *Ionic* ORDER is the third, and a kind of mean Proportional between the solid and delicate Manner. Its Capital

its adorn'd with Volutes, and its Cornice with Denticles.

Michael Angelo, contrary to all other Authors, gives the *Ionic* a single Row of Leaves, at the Bottom of the Capital.

The first Idea of this Order was given by the *Ionians*, who according to *Vitruvius*, compos'd this Column on the Model of a young Lady, dressing in her Hair, of an easy and delicate Shape; as the *Doric* had been form'd on the Model of a strong robust Man.

It is said, the Temple of *Diana* at *Ephesus*, the most celebrated Edifice of all Antiquity, was of this Order.

It may now be us'd in Buildings of Piety, as in Churches, Courts of Justice, in Apartments of Ladies, and in other Places of Quietude and Peace.

The *Corinthian* ORDER invented by *Calimachus*, is the fourth, the richest and the most delicate. Its Capital is adorn'd with two Rows of Leaves, and eight Volutes, which sustain the *Abacus*. Its Column is ten Diameters high, and its Cornice has Modillions.

This is indeed a Master Piece of Art, for which we are indebted to the City of *Corinth*. It ought always to be us'd in most stately and most magnificent Buildings.

The *Composite* or *Roman* ORDER, is the fifth and last (tho' *Scammozzi* makes it the fourth). It is call'd the *Composite*, because its Capital is compos'd out of those of the other Orders; having two Rows of Leaves of the *Corinthian*, and the Volutes of the *Ionic*. It is also call'd the *Roman*, because invented among that People. Its Column is ten Diameters high; and its Corniche has Denticles or simple Modillions.

This Column has also a Quarter Round as the *Tuscan* and *Doric*. Most of our Architects in Compliance with Usage and Custom, place this after the *Corinthian*; doubtless because it was the last that was invented. *Scammozzi* is the only Author who varies from the Rule, but he does it with so much Judgment, that we scruple not to imitate him.

This Order may be us'd in every Place, and on every Occasion, where 'tis requir'd that Strength, Richness and Beauty should be found together.

Rustick ORDER is that adorn'd with Rustick Quoins, Boscages, *&c.*

Attick ORDER is a little *Order* of low Pilasters, with an architrav'd Corniche for its Entablature, as that of the Castle of *Versailles*, over the *Ionic*, on the Side of the Garden.

M. *Blondel* calls the little Pilasters of *Atticks* and *Mezzanines*, false *Orders*.

Persian ORDER is that which has Figures of *Persian* Slaves, instead of Columns to support the Entablature.

Caryatick ORDER, is that whose Entablature is supported with Figures of Women instead of Columns.

Gothic ORDER, is an Order which deviates from the Ornaments and Proportions of the Antique; and whose Columns

lumns are either too massive, in Manner of Pillars; or too slender, like Poles; its Capitals out off all Measure; and carv'd with Leaves of wild *Acanthus*, Thistles, Cabbage, or the like.

French ORDER, is a new contriv'd *Order*, wherein the Capitals consist of Attributes agreeing to that People, as Cock's Heads, Flower de Lys, *&c.*

The Proportions of this Order are *Corinthian*. Such is that of M. *Le Brun*, in the grand Gallery of *Versailles*, and that of M. *Le Clerc*.

M. *Le Clerc* gives a second *Tuscan* Order, and a *Spanish* Order, besides his *French* Order. The *Tuscan* he ranks between the first *Tuscan* and *Doric*. He makes the Height of it 23 Semi-Diameters, 22 Minutes; the Columns to have 15, the Pedestal 5, and the Entablature 3 and 22 Minutes, and he proposes its Frieze to be adorn'd with Turtles; which are the Arms of *Tuscany*.

He places the *Spanish* Order between the *Corinthian* and *Composite*. He makes the whole Order 50 Semi-Diameters, 28 Minutes; the Column of which has 19 and 25 Minutes, the Pedestal 16, and 18 Minutes, and the Entablature, 4 and 15 Minutes.

The Horns of the *Abacus* he sustains with little Volutes; the middle, in Lieu of a Rose, has a Lion's Snout; that Animal being the Symbol of *Spain*, and expressing the Strength, Gravity and Prudence of that Nation.

These several Orders, says M. *Le Clerc*, speaking of the five first, have been very judiciously compos'd at various Times, in order to suit the various kinds of Buildings, which either Necessity or Magnificence should occasion Men to erect, and these are ever made more or less simple, each in its Kind; and more or less slender, according to the Buildings they are us'd in, and the Riches of the Princes, People, or private Persons who build them.

M. *Le Clerc* treats of the different Manners wherein the five Orders or Columns have been treated, with some useful Remarks on those of *Palladio* and *Vignola*.

He says, if these Orders of Columns had any positive Beauties, easy and obvious to the Eye, Architects would have been oblig'd to agree among themselves, as to their Rules and Properties; but as their Beauties are in Effect merely arbitrary, and not founded on any certain Demonstrations, it happens, that those who have treated of them, have all prescrib'd different Rules, according as their Taste and Genius were different.

It must be own'd however, that tho' the same Order may have different Beauties, and different Proportions; yet among those Beauties and Proportions, 'tis certain there are some that please more, and are more universally approv'd than others.

Among the several Authors who have written on Architec-

ture, *Palladio* and *Vignola* ſeem to be the moſt generally follow'd; but it is a Doubt, even among Perſons of Skill and Judgment, which of the two ought to be preferr'd to the other.

The Orders of *Palladio* have Beauties different from the Orders of *Vignola*. I mean their ſeveral Orders have each of them their different Beauties; and yet the great Difference between their Compoſitions, does hardly allow us to view them without making a Choice from ſome Circumſtances.

For Inſtance, *Vignola*'s Rule of making the Entablement in all the Orders juſt a fourth Part of the Height of the Column, pleaſes me leſs than that of *Palladio*, who diminiſhes this Height in the three laſt Orders. I mean that *Vignola*'s Entablements appear heavy and lumpiſh, and eſpecially in the *Ionic*, *Corinthian* and *Compoſite* Orders; and above all, when the Columns are without Pedeſtals,

On the other Hand, *Vignola*'s Pedeſtals, whoſe Height in all the Orders is one third of that of the Columns, are in my Opinion preferable to the Pedeſtals of *Palladio*, which having leſs Height, appear flat and low.

Again, the *Zocco* of *Vignola*'s Pedeſtal ſeems too little, and that of *Palladio*, too big and ſtrong for the Pedeſtal.

Further, I cannot commend *Vignola* for giving *Vitruvius*'s Baſe to the *Ionic* Column, and for excluding the *Attic* Baſe out of all his Orders, which, without Diſpute, is the moſt beautiful of all the Baſes of Columns.

Palladio too, in my Opinion, had done better, if in Imitation of the Ancients he had given the *Attic* Baſe to the *Ionic* Column, inſtead of the *Doric*; in which laſt ſome more ſimple Baſe, as that for Inſtance of *Vignola*, would have been more ſuitable and conſiſtent with the Solidity of the Order.

Add to theſe that a Man cannot view *Vignola*'s *Tuſcan* Order, without obſerving that of *Palladio* ill conducted almoſt in every Part; but eſpecially in the Shaft of the Column, which indeed appears monſtrous, on Account of its exceſſive Diminution towards the Top; even the ſmalleſt Share of Diſcernment is ſufficient to diſcover this.

Methinks too, it had been more juſt in *Palladio*, if inſtead of Modillions in the *Ionic* Entablement, he had made Dentils, which, as *Vignola* has very well obſerv'd, are an eſſential Ornament of this Odrer: Modillions appearing too ſtrong and maſſive for a Column that profeſſes to imitate the Delicacy of a young Woman.

Nor does it appear over judicious in *Vignola*, to uſe Dentils in four of the Orders; it being a Point of Prudence in an Architect, to introduce a Diverſity in the Ornaments, as well as the principal Members of his Orders.

And again, I can't but think it an overſight in *Vignola*, to make

make his Dentils leſs in the *Doric* Order, than in the *Ionic*, *Corinthian* and *Roman*; when 'tis own'd, that the *Doric* is conſiderably leſs delicate than any of thoſe other Orders.

Who can approve of *Palladio*'s making the *Corinthian* Column leſs delicate than the *Roman*, and the *Roman* Capital at the ſame Time leſs delicate than the *Corinthian*? Or was it juſt in *Vignola* to make the 2 Columns, *Corinthian* and *Compoſite*, in the ſame Proportion?

Ought not ſome Regard to be had to the Difference of their Capitals, and on that Account, ſhould not ſome more Delicacy be ſhewn in the *Corinthian* Column, than the *Roman?*

Further it may be juſtly ſaid, that if *Vignola* has made his Entablements too heavy in the three laſt Orders, *Palladio* has made his too light.

I obſerve alſo, that *Vignola* has made his Modillions in the *Corinthian* Order, too large, inſomuch that they encroach upon each other in the inner Angles of the Entablement; on which Account, the Roſes inclos'd between them, appear too ſmall, with Regard to thoſe; which muſt be own'd to be a conſiderable Fault, that *Palladio* had the good Fortune to avoid, by making the Spaces between the Modillions perfect Squares.

Nor can it be deny'd that in *Vignola* the Die of the *Corinthian* Pedeſtal is too high, and in *Palladio*, too low for the Baſe.

Laſtly, a Man cannot view *Vignola*'s Portico's, without obſerving them to be better proportioned than thoſe of *Palladio*, which are too wide in the two firſt Orders, and too narrow in the two laſt.

Were I to examine the Profiles of theſe two Authors, many of them would be found intolerable; being compos'd of Mouldings that are ill match'd to each other, and in no wiſe ſuitable to the Places where they are found.

Of the five Orders of Architecture, *by equal Parts.*

Every *Order* is comprehended under three principal Parts, *viz.* the *Pedeſtal*, the *Column* and the *Entablature*; and each Part conſiſts of three Denominations; the *Pedeſtal* having its *Baſe*, *Die*, and *Cornice*; the *Column*, its *Baſe*, *Shaft*, and *Capital*; and the *Entablature*, its *Architrave*, *Frieze* and *Cornice*.

I. *Of the* Tuſcan *Order.*

Any Height being given, divide it into ten Parts and three Quarters, call'd Diameters (by Diameters is meant the Thickneſs of the Shaft at the bottom) the Pedeſtal having two; the Column with Baſe and Capital, ſeven; and the Entablature, one and three Quarters.

II. *Of the* Doric *Order.*

The whole Height being given, is divided into twelve

Diameters or Parts, and one third; the Pedestal having two and one third, the Column eight, and the Entablature two.

III. *Of the* Ionic *Order.*

The whole Height is divided into thirteen Diameters and a half; the Pedestal having two and two thirds, the Column nine, and the Entablature one, and four fifths.

IV. *Of the* Corinthian *Order.*

The whole Height is divided into fourteen Diameters and a half; the Pedestal having three, the Column nine and a half, and the Entablature two.

V. *Of the* Composite *Order.*

The whole Height is divided into fifteen Diameters, and one third; the Pedestal having three and one third, the Column ten, and the Entablature two.

In a *Colonade* or range of Pillars, the *Intercolumniation* or Space between two Columns in the *Tuscan* Order, is four Diameters. In the *Doric* Order, two and three Quarters. In the *Ionic* Order, two and a Quarter. In the *Corinthian* Order, two: And in the *Composite* Order, one and a half. See the Plate.

ORGANICAL *Description of Curves* is the Method of describing them on a Plane, by the Regular Motion of a Point.

ORLE, ORLET, ORLO [in *Architecture*] a Fillet under the Ovolo or Quarter Round of a Capital. When it is at the Top or Bottom of the Shaft, it is call'd *Cincture*. *Palladio* uses the Word for the Plinth of the Bases of Columns.

ORNAMENTS [in *Architecture*] are us'd to signify all the Sculpture or carv'd Work wherewith a Piece of Architecture is enrich'd.

Vitruvius and *Vignola* also use the Word to signify the *Entablature*.

Ornaments in Relievo are those cut into the Contours of Mouldings, as Leaves, Shells, Scrolls, Flowers, &c.

Ornaments in Creux, are such as are cut within the Mouldings, as *Eggs*, *Flutes*, &c.

ORPIMENT is the same that some call *Yellow Arsenick*. It is a good Colour for some Uses, but is very troublesome to grind, being a mineral, stony Substance of a poisonous Quality; therefore Care ought to be taken, that the Fumes of it don't offend the Brain, in the time of grinding it.

ORTHOGRAPHY [in *Geometry*] is the Art of drawing or delineating the fore right Plan of any Object, and of expressing the Heights or Elevations of each Part.

It is call'd *Orthography* from its determining Things by perpendicular Lines, falling on the Geometrical Plane.

ORTHOGRAPHY [in *Architecture*] is the Elevation of a Building.

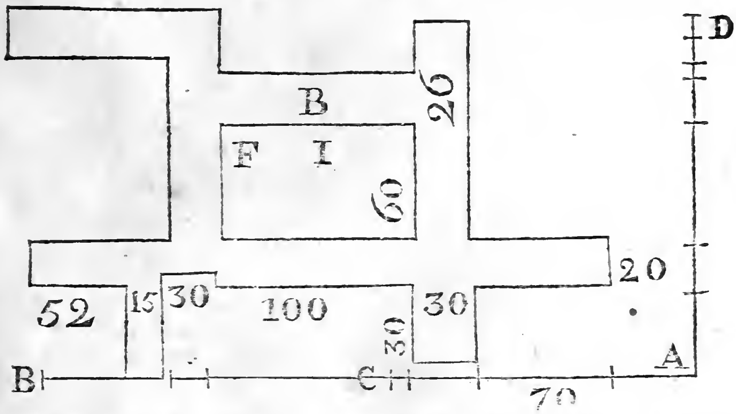
The

The *Orthography* is either *external* or *internal*.

The *external Orthography* is taken for the Delineation of a external Face or Front of a Building; or as it is by others defin'd, is the Model, Plat-form, and Delineation of the Front of a Houſe, that is contriv'd, and to be built according to the Rules of *Geometry*, according to which Pattern the whole Fabrick is erected and finiſh'd. This Delineation or Plat-form, exhibits the principal Wall, with its Apertures, Roof, Ornaments, and every Thing viſible to an Eye, plac'd before the Building.

Internal Orthography, which is alſo call'd a *Section*, is a Delineation, or Draught of a Building, ſuch as it would appear, were the external Wall removed.

To lay down the Orthography of a Building.



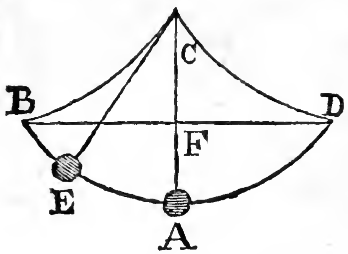
Draw a Right Line for a Baſe or Ground Line A B, and at one End erect a perpendicular A D upon A B, ſet off the Width and Diſtances of the Gates or Doors, Windows, &c. On the Right Line A D, ſet off the Heights of the ſeveral Parts viſible in the Face of the Building, *v. g.* of the Doors, Windows, the Roof, Chimneys, *&c.* and apply a Ruler to each Point of Diviſion.

The common Interſections of the Right Lines, drawn from three Points, parallel to the Lines A B and A D determine the external *Orthography* of the Building; and after the ſame Manner, is the internal Orthography to be laid down.

ORTHOGRAPHY [in *Perſpective*] is the fore right Side of any Plane, *i. e.* the Side or Plane that lies parallel to a ſtrait Line, that may be imagin'd to paſs through the outward Convex Points of the Eyes, continued to a convenient Length. *Lamy*, and others, uſe the Word *Scenography* in the ſame Senſe.

OSCILLATION [in *Mechanicks*] is the Swing or reciprocal

procal Aſcent or Deſcent of a Pendulum.



1. If a ſingle Pendulum be ſuſpended between two Semi-Cycloids B C, C D, which have the Diameter C E of the generating Circle equal to half the Length of the String, ſo that the String, as it oſcillates, folds about them; all the Oſcillations, however unequal, will be Iſochronal in a non reſiſting Medium.

2. The Time of the intire or whole Oſcillation thro' any Arch of a Cycloid, is to the Time of the Perpendicular Deſcent through the Diameter of the generating Circle, as the Periphery of the Circle to the Diameter.

3. If two Pendulums deſcribe Similar Arches of Circles, the times of the Oſcillations are in the Subduplicate of their Lengths.

4. The Number of Iſochronal Oſcillations made in the ſame time by two Pendulums, are reciprocally as the times wherein each of the Oſcillations are made.

The Times of the Oſcillations in different Cycloids, are in the ſub-duplicate Ratio of the Length of the Pendulums.

5. The Length of a Pendulum that will perform its Oſcillations in a Second, is 3 Foot, 8 Inches and a half of *Paris* Meaſure.

6. The ſhorter the Oſcillations in the Arch of a Circle are, the truer will the Pendulum meaſure Time, or the more Iſochronal will the Oſcillations be.

Centre of OSCILLATION in a ſuſpended Body, is a certain Point therein, each Vibration of which is perform'd in the ſame Manner, as if that Point alone were ſuſpended at that Diſtance from the Point of Suſpenſion. Or,

It is a Point wherein, if the whole Length of a compound Pendulum be collected, the ſeveral Oſcillations will be perform'd in the ſame Time as before.

Therefore its Diſtance from the Point of Suſpenſion is equal to the Length of a ſingle Pendulum, whoſe *Oſcillations* are Iſochronal with thoſe of the Compound one.

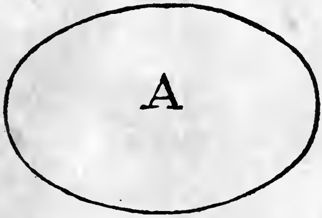
OVA [in *Architecture*] are Ornaments in Form of Eggs, carv'd on the Contour of the Ovolo or Quarter Round; and ſeparated from each other by Anchors, or Arrow Heads, theſe Ornaments are ordinarily call'd *Eggs* and *Anchors*, by the *Engliſh*.

The Ancients ſometimes us'd Hearts inſtead of Eggs, upon which Foundation it was, that they us'd Arrows to ſymbolize with Love.

OVAL or *Ellipſis* [in *Geometry*] is a Figure as A bounded by a regular curve Line,

return-

returning into it ſelf; but of its two Diameters cutting each other at Right Angles in the

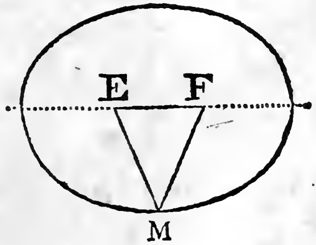


Centre, one is longer than the other, in which it differs from the Circle. Every *Ellipſis* is an *oval* Figure, but every *oval* Figure, is not an *Ellipſis.* Or,

An Oval may be defin'd a Figure inclos'd with a ſingle curv'd Line, imperfectly round, its Length being greater than its Breadth; like an Egg, whence it takes its Name.

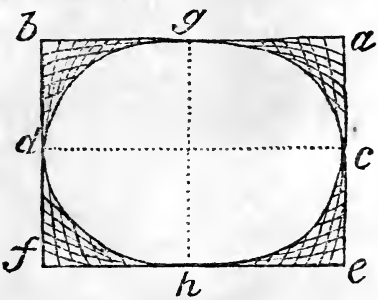
The proper Oval or Egg Shape, is an irregular Figure, being narrower at one End than the other; in which it differs from the Ellipſis, which is the mathematical Oval, and equal in Breadth at each End.

Theſe two are confounded together by the common People, and even Geometricians call the Oval a falſe Ellipſis.



The Method commonly us'd by Workmen in deſcribing an Oval, is by a Cord or String, as F M E, whoſe Length is equal to the greater Diameter of the Oval, and which is faſtened by its Extremes to two Points or Nails, E, F, planted in its longeſt Diameter, by which Means the Oval is made as much longer, as the two Points or Nails are farther apart.

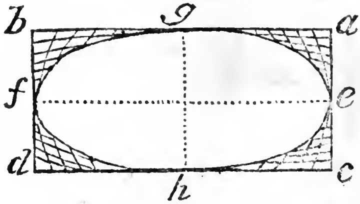
To draw an Oval by Interſection of Right Lines.



Firſt, Deſcribe the out Lines *a b*, *b e*, *f e*, and *e a*, at Right Angles to each other; afterwards draw the Conjugate Diameter *c d*, alſo the tranſverſe Diameter *h g*, and divide *a g*, and *a c* into any Number of equal Parts; alſo *c b* and *b d*, *d e*, and *f h*; and *h e* and *e c*, and draw Right

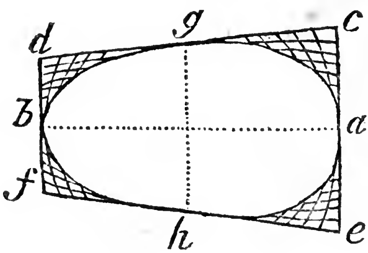
Right Lines from Division to Division, as before, which will describe the Oval *c, g, d, h,* which was to be done.

To describe an Oval, whose Transverse Diameter is less than in the preceeding next immediately preceeding.



First, Draw the Out-Lines *a b, b d, d c,* and *c a,* at Right Angles to each other; and afterwards draw the conjugate Diameter *e f,* also the transverse Diameter *g h*; then divide *a g* and *a e* into any Number of equal Parts; also *g b* and *b f*; *f d,* and *d h* *h c* and *c e,* from which, draw Right Lines as before, which will describe the Oval *e g f h.*

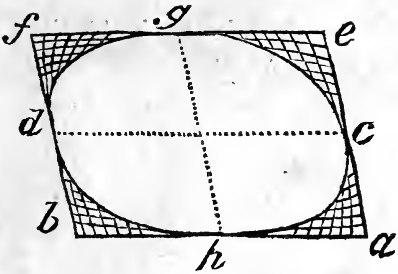
To draw an Egg or Oval, one End larger than the other.



First, Draw the conjugate Diameter *a b,* afterwards draw Lines *e c* and *f d* at Right Angles with *a b,* so that *a c* is equal at *a e* and *b f* is equal to *b d*; then draw the Lines *c d* and *e f,* which divide in the middle at *g* and *h,* and draw the Line *g h* for the transverse Diameter; then divide *e h,* and *e a,* and also *a c,* and *c g* into any Number of equal Parts; and divide *h f, f b, b d,* and *d g* into any Number of equal Parts, and draw Right Lines to each Correspondent Division, and they will describe the Figure *a g, b h,* which is what was to be done.

To draw an oblique Oval.

First, Describe the Out-Lines *a b, a e, e f* and *f b,* and draw the conjugate Diameter *c d*; also the transverse Diameter *h g*; and observe that *e f* is equal to *a b,* and *b f,*



is equal to *a e*: then divide each Line, that is, between Letter and Letter, into one equal Number of Parts, and draw Right Lines as before, which will deſcribe the Oval *c g d h*, which was requir'd.

OVOLO [in *Architecture*] is a round Moulding, whoſe Profile or Sweep in the *Ionic* and *Compoſite* Capitals, is uſually a Quadrant of a Circle; whence it is alſo popularly call'd the *Quarter Round*.

It was uſually enrich'd with Sculpture by the Ancients, in the Form of Cheſnut-Shells, whence *Vitruvius* and others call'd it *Echinus*, *i. e. Cheſnut-Shells*.

Among us, it is uſually cut in the Likeneſs of Eggs and Anchors, or Arrow-heads, plac'd alternately.

OVICULUM [in the ancient *Architecture*] a little Ovum or Egg.

OVER-SPAN. See *Clamp*.

OXYGONE, [in *Geometry*] is the ſame as an acute angled Triangle.

OXYGONAL } [in *Geometry*]
OXYGONOUS }
ſignifies acute angled; ſomething with an Angle leſs than 90 Degrees.

P.

PADDUCK, or *Paddock Courſe*, a Piece of Ground conveniently taken out of a Park, uſually a Mile in Length and a Quarter of a Mile in Breadth, encompaſs'd with Pales or a Wall, for exhibiting Races with Grey-Hounds, for Wagers, &c.

PAINTING [*in Oil*] the Art of Painting in Oil, was unknown to the Ancients, and was firſt diſcovered and put in practiſe in the Beginning of the XIV Century, by a *Flemiſh* Painter, nam'd *John van Eyck*, or *John de Bruges*. Painting before his Time, was all perform'd in *Freſco* or Water Colours.

This Invention was of very great Uſe to the Art of Painting, ſince by Means hereof, the Colours of a Painting, are preſerv'd much longer and better, and receive a Luſtre and Sweetneſs, which the Ancients could never attain to, what Varniſh ſoever they made Uſe of, to cover their Pieces.

The whole Secret conſiſts only in grinding the Colours with Nut-Oil or Linſeed Oil: but the Manner of working is

very different from that in *Fresco*, or in Water, by Reason that the Oil does not dry near so fast; so that the Painter has an Opportunity of touching and retouching all the Parts of his Figures, as often as he pleases; which in the other kinds of Painting is a Thing impracticable.

And besides, the Figures in this Way of Painting, have more Force and Boldness, in as much, as the Black becomes blacker when ground with Oil, than with Water. Besides, that all the Colours mixing better together, render the Colouring sweeter, softer, more delicate, and give an Union and Softness to the whole Work, which is inimitable in any of the other Manners.

Painting in Oil, is perform'd on Walls, Wood, Stone, *&c.* To paint on a Wall, when it is well dry, they give it two or three Washes of boiling Oil, till the Plaister remain quite greasy, and will imbibe no more. Upon this they lay drying Colours, *viz.* white Chalk, red Oker, or other Chalks, beaten pretty stiff. When this Couch or Lay is well dry, they sketch out and design the Subject to be painted, and at last paint it over, mixing a little Varnish with their Colour, to save the varnishing afterwards.

Others to fortify the Wall better against Moisture, cover it with a Plaister of Lime, Marble Dust, or a Cement made of beaten Tiles soak'd in Linseed Oil; and at last they prepare a Composition of *Greek* Pitch, Mastick, and thick Varnish boil'd together. which is apply'd hot over the former Plaister: When this is dry, they lay their Colours on as before.

Others make their Plaister with Lime, Mortar, Tile Cement, and Sand; and when this is dry, they lay on another of Lime, Cement or Machefer, or Iron Scum; which being well beaten and incorporated with Whites of Eggs and Linseed Oil, makes an excellent Couch or Plaister, on which when it is dry, the Colours are laid as before.

In painting on Wood, they usually give their Ground a Couch or Lay of White, tempered with Size; or they apply the Oil above-mention'd: the Rest is after the same Manner as in painting on Walls.

To paint on Linnen or Canvas. The Canvais being stretch'd on a Frame, they give it a Couch or Lay of Size: When it is dry they go over it with a Pumice-Stone, to smooth off the Roughness. The Size lays all the little Threads and Hairs close on the Cloth, and the little Holes are stopp'd up, that no Colour can come through.

When the Cloth is dry, they lay on Oker, which is a natural Earth, and bears a Body, sometimes mixing with it a little white Lead to make it dry the sooner, and when it is dry, they rub it with a Pumice Stone to make it smooth.

After this, sometimes is added a second Lay, compos'd of White Lead and a little Char-

coal black, to render the Ground of an Ash Colour; taking Care in each Manner to lay on as little Colour as possible, that the Cloth may not break, and that the Colours when they come to be painted over, may preserve the better.

Therefore as little Oil as possible is to be us'd, if you would have the Colours keep fresh; and therefore some mix them up with Oil of Aspic, which evaporates immediately, and serves to make them manageable with the Pencil.

To paint on Stones, it is necessary to apply Size, as on Cloth; it will be sufficient to add a slight Couch of Colours, before the Design is drawn.

PAINTING of *Timber Work*. The Manner of colouring all Manner of Timber-Work, as Wainscot, Doors, Windows, Posts, Rails, Pales, Gates, Border Boards for Gardens, *&c.* which require either Beauty or Preservation from the Violence of Rain, or Injury of Weather, is as follows.

Suppose there be a Set of Pallisades, or a Pair of Gates, or some Posts and Rails to be painted in a Stone Colour.

First, Look over the Work, and take Notice whether the Joints be open in the Gates, or whether there be any large Clefts in the Posts; for if these are not secur'd, the Wet will insinuate it self into those Defects, and make the quicker Dispatch in rotting the whole Work.

Therefore the first Thing to be done, is to stop up those Clefts, *&c.* smooth and even, with a Substace which Painters call *Putty*, which is made of Whiting and Linseed Oil, well beaten together on a grinding Stone, or with a wooden Mallet, to the Consistence of a very thick Dough, and with this, let all the Crannies, Clefts and other Defects be well fill'd up, so that it may be equal to the Surface or out Side of the Things to be painted.

Then Prime the Work with *Spanish* Brown, well ground, and mixt very thin with Linseed Oil; with this do over the Work, giving it as much Oil as it will drink up; this in about two Days will be indifferent dry; then if you would do the Work substantially, do it again with the same Priming Colour; when it is thorough dry, take White Lead, well ground and tempered with Linseed Oil, but not too thin; for the stiffer you work it, if it be not too stiff, the better Body will be laid on, and the longer it will last; rub this Colour on well with a large Bristle Brush; that the whole Surface of the Work be so intirely covered, that no crack nor corner may remain bare; which may be easily done by jobbing in the Point of a Bristle Brush.

Let this first Colouring dry, and then go over it a second time, and if you please, a third also; the Charge will be but little more, but the Advantage will be great in the Duration.

This Course is sufficient for every

every Kind of Timber Work, which requires only a plain Colour; whether you cover the Work with a Stone Colour, or elſe with a Timber Colour with Umber and White, or a Lead Colour with Indigo and White.

Some lay over their Work only a Coat of *Spaniſh* Brown, by tempering it up more ſtiff than was done for the two firſt Primings, which, in ſome Reſpects, is the cheapeſt Way of all, and preſerves the Timber perhaps as well as Any.

Note, If when you have made Uſe of your Colours, there be Occaſion for a ſmall Ceſſation, till the Work be finiſh'd; in this Caſe, you muſt cover the Colour that remains in the Pot with Water, which will prevent its drying and ſkinning over.

And the Pencils alſo or Bruſhes ſhould be waſh'd out in clear Linſeed Oil; and then in warm Soap Suds; for if either Oil or Colours be once dry'd in the Bruſh, or Pencil, they are ſpoil'd for ever.

It has been obſerv'd, that Timber laid over with White when it has ſtood ſome time in the Weather, the Colour will crack and ſhrink up together, juſt as Pitch does, if laid on any Thing that ſtands in the Sun; the Cauſe of this is that the Colour was laid on with too ſtiff a Body; for being wrought too thick once, it will dry with a Skin on the Outſide, which will keep the Inſide moiſt, and prevent its binding firm, from whence thoſe Cracks proceed.

Of Out-Door painting in General.] Doors, Shop-Windows, Window-Frames, Pediments, Architraves, Friezes and Corniches, and all other Timber Works that are expos'd to the Weather, ought at firſt ſetting up, to be prim'd with *Spaniſh Brown*, *Spaniſh White*, and *Red Lead* (about a fifth) to cauſe the other two Colours to dry.

Theſe being well ground with Linſeed Oil, will make a very good Primer: Then afterwards with the ſame Colour, (but whiter) for a ſecond Primer, and laſtly with a fair White, made of White Lead, and about a fifth Part in Quantity, (not in Weight) of *Spaniſh White*.

Now he that is able to bring the Work thus far on, has proceeded to the higheſt Pitch of that vulgar Painting, that aims at Preſervation beyond Beauty, tho' ſomething of Beauty is neceſſarily included in this alſo; but this is not all, for he that is arriv'd thus far, is in a fair Way to other Perfections in the Art of Painting; but for the Panelling of Wainſcot with its proper Shadows, and for imitating Olive and Walnut Wood, Marbles, and ſuch like, theſe muſt be attain'd to by ocular Inſpection, it being impoſſible to deliver the Manner of the Operation by Precept, without Example; and I am bold to affirm, that a Man ſhall gain more Knowledge by one Day's Experience, than by an Hundred ſpent to acquire it ſome other Way.

I advise therefore all those that desire an Insight into the Business, to be a little curious, if Opportunity offers, in observing the Manner of a Painter's Working, not only in grinding his Colours, but also in laying them on, and working in them; in all these observing the Motion of his Hand, in the manage of any Kind of Tool; and by this Means, with a little Imitation, join'd to the Directions here given; I doubt not but in a short time, you may arrive to great Proficiency in the Business of vulgar Painting.

Take Notice, that if you shall at any Time have Occasion to use either Brushes that are very small, or Pencils, as in many Cases there will be Occasion, you ought then to dispose of the Colours you use upon a Pallet (*which is a wooden Instrument, easy to be had at any Colour-Shop*) and there work and temper them about with your Pencil, that the Pencil may carry away the more Colour; for you are to *Note*, that if a Pencil be only dipt in a Pot of Colour, it brings out no more with it than what hangs on the Outside, and that will work but a little way, whereas if you rub the Pencil about in the Colour, on the Pallet, a good Quantity of Colour will be taken up in the Body of the Pencil; and besides all this, you may work your Pencils better to a Point on a Pallet, than you can do in a Pot; the Point of a Pencil being of greatest Use in divers Cases, especially in drawing of Lines, and all kind of Flourishing.

How to scour, refresh and preserve all Manner of Oil Paintings.

The Oil Paintings that I here intend, are only such as are kept from the Injuries of Weather; for such Paintings as endure the Fury of Rain and Storms (such as Sun-Dials, Posts, Pales, &c.) are not any ways to be renewed or refreshed, but by being new coloured with the same Colour, in which it was at first wrought, because that the Body and Strength of the Colour, is worn out by continual Assaults of wasting Time, and cannot be made fresh, unless new done over once in four or five Years, or more according as the Weather is found to wear it off, and make it look dull.

But as for such Painting that is shelter'd from Weather, as all In-Door Paintings are, they still keep their Body and Colour, although their Beauty may be much impaired by Dust, Smoak, Fly-shits, and the like, which will in time soil and tarnish them; to remedy which, take these few Rules:

If your Painting be Wainscotting, or any other Joinery or Carpentry Work that is painted in Oil, take Wood-Ashes well sifted, which mix with Water somewhat thick, then take a large strong Bristle Brush, and dip it in the moistened Ashes, and therewith rub and scour your Painting all over

over very gently in all Places alike, and you will find that all the Soil is taken off, then wash it clean with fair Water, and let it dry; and you will find your Painting to be near as fresh as when laid on.

But if your Painting be more curious, whether Figures of Men, Beasts, Landskip, Frutage, Florage, or the like, then let your Picture be gently scoured, and then cleanly washed off with fair Water; after it is well dry, let it be run over with Varnish, made with White of Eggs, and you will find the Beauty and Lustre of your Picture much recovered.

The Whites of Eggs beforementioned, are only to be beaten to an Oil, and then curiously rubbed on either with a clean Linnen-Cloth, or a Pencil.

But *Note*, That this scouring of Pictures ought not to be practised but very seldom (*as when your Picture is very much soiled*) because often and too frequent doing this, must needs wear off a little of the Colours; therefore strive what you can to preserve their first Beauty, by keeping them free from Smoak, and by often striking off the Dust with a Fox-Tail; as likewise preserving them from Flies, by burning Brimstone sometimes to kill them, or by dressing up your Rooms with green Boughs, to which the Flies will gather themselves, and so not hurt your Pictures.

Sir *Hugh Platt* in the first Part of his *Garden of Eden*, and 17 *Page*, tells us of an *Italian* Fancy for that Purpose, by hanging in the Roof and Sides of the Room small Pompions or Cucumbers stuck full of Barley, which will sprout into green Spiers, on which the Flies will lodge. *Query*, Whether a Vessel of Tin made round about full of Holes filled with Earth, and every Hole planted with a Corn of Barley, and watered as Need requires, would not be more beautiful and useful to this Purpose?

Another Note worth Observation is, that all Pictures (*especially those that are wrought with Mixtures of White Lead*) are apt to tarnish and grow rusty, as is seen in all ancient Pieces; to prevent which, in the Months of *May* and *June*, let your Pictures be exposed sometimes to the hot Sun, for this will draw off much of the tarnish, and make the Colours more fresh and beautiful: and thus doing from Year to Year, will preserve them wonderfully.

Out Door Work thus coloured, may be afforded to be done for 3*d.* 3½*d.* or 4*d.* the Yard Square, for each time laid over.

Of Measuring.] Painters measure their Work by the Yard superficial, and in taking the Dimensions of their Work, they run a String all over where the Brush has been, for they say (and it is but Reason) that they ought to be paid for all where the Brush goes.

But sometimes in Rails or Bannisters, they will measure it,

it, as if it were flat Measure; and indeed upon trying the Experiment, there has been so little Difference found, that it would not countervail the Trouble of girting and casting up.

So that Painters Work is measured the same as Joiners, only Painters never reckon Work and Half, but work once, twice, three times, *&c.* done over; or at so much *per* Yard, according to the Work.

They always reckon double Work for painting Window Shutters, if both Sides are painted alike, otherwise according to the Value of the Painting.

They reckon Sash-Frames by themselves (at so much *per* Piece, and likewise Mantle-Pieces) when there is no Painting about them; but if they stand in the Wainscot, they measure them as plain Work, not deducting any Thing for the Vacancy.

Wainscot Colour] If on new Stuff, is worth about 8 *d. per* Yard, on old Colour, about 7 *d.*

Walnut-Tree Colour.] Some say it is worth 10 *d.* but others, 16 or 18 *d. per* Yard.

Ordinary branch'd Painting] It is said to be worth 12 *d.* 14 *d.* or 16 *d. per* Yard.

Ordinary Marble Colour.] If on new Stuff, is worth 1 *s. per* Yard, on old Stuff, 9 *d.*

White Colour] is worth 10 *d.* or 1 *s. per* Yard.

Plain Japan, either black or white] is worth 3 *s.* 6 *d.* or 4 *s. per* Yard.

Gates and outward Doors] are worth 3 *d.* 3½ *d.* or 4 *d. per* Yard.

Shop-Windows] are of the same Price as Gates and outward Doors.

Window Frames] are worth from 3 *d.* to 8 *d.* each Light, according to their Size.

Sash-Lights] are worth about 1 *s. per* Light.

Sash-Frames] are worth about 1 *s. per* Frame.

Iron Casements] are worth Three Half pence, 2 *d.* or 3 *d. per* Casement, according as they are in Bigness.

Iron Bars of Windows] are worth 1 *d. per* Bar, or more, if very large.

Chimney-Pieces] are worth about 2 *s. per* Chimney-Piece.

Pales are worth about 10 *d.* or 1 *s. per* Yard.

Colours.] The Colours us'd in Painting are, *White* and *Red Lead*, *Spanish*, *White Brown*, *Verdigrease*, *Smalt*, &c.

Painters Work.

The taking of the Dimensions, is the same with that of Joiners, by g rting over the Mouldings *&c.* in taking the Height, and it is but reasonable that they should be paid for what both their Time and Colour are expended in. The casting up after the Dimensions have been taken and reduc'd into Yards, is altogether the same with that of Joiners Work; but the Painter never reckons Work and Half; but reckons his Work once, twice or thrice colour'd over.

But this is to be remembred, that Window-Lights, Window-Bars, Casements, and such like

 Things,

Things, are done at ſo much *per* Piece.

Example. If a Room be painted, whoſe Height (being girt over the Mouldings) is 16 Feet 6 Inches, and the Compaſs of the Room be 97 Feet 9 Inches, how many Yards are in that Room?

Multiply 97 Feet 9 Inches, by 16 Feet 6 Inches, and the Product will be 1612 Feet, 10 Inches, 6 Parts; which being divided by 9, the Quotient will be 179 Yards and 1 Foot.

F.	I.	
97	9	
16	6	
584		
98		
48	: 10	: 6
9)1612	: 10	: 6

```
 97.75
  16.5
 -----
 48875
58650
9775
--------
1612.875
```

Facit 179 Yards, 1 Foot.

By Scale and Compaſſes.

Extend the Compaſſes from 9 to 16.5, and that Extent will reach from 97.75 to 179 2 Yards.

PALE [in *Carpentry*] a little pointed Stake of Wood, us'd in making Incloſures, Separations, &c.

PALES } PILES } are Rows or Files of Stakes driven into the Ground, to make wooden Bridges over Rivers, they ſerve to ſupport the Beams which are laid acroſs them from one Row to another; and are ſtrongly bound together with croſs Pieces.

PALEING with cleft Pales, Rails and Poſts. For paleing with 3 Rails, Cleft Pales, Rails and Poſts, cleaving, making, and ſetting up, the uſual Price is ſaid to be 3 *s.* 6 *d.* or 4 *s.* *per* Rod, felling the Timber and all; but then they muſt have their Materials all laid down to their Hand, ſo that they have no carrying.

Some ſay they have 2 *s.* 6 *d.* *per* Rod for only making and ſetting up of Clefts Poſts, Rails, and Pales.

Sawn Pales, Rails and Poſts, ſome ſay are ſet up at 1 *s.* 6 *d.* *per* Rod.

The Price of Cleaving Pales is about 20 *d.* or 2 *s.* *per* Hundred.

A hundred of Pales varies according to their Length; for of five Foot Pales, five Score makes a hundred; of four Foot Pales, ſix Score, and of three Foot, ſeven Score go to the Hundred.

It is very uncertain what Number a Tun of Timber will make, by Reaſon of the Difference of the Timbers cleaving, ſome cleaving much better (and with leſs waſte) than other.

But

But a Tun of good cleaving Timber, may make about 300 of 4 Foot Pales, or 400 of 3 Foot Pales; because the Timber generally cleaves better and less to waste in short Lengths, than in longer.

But the Number of *sawn Pales* that may be made out of a Tun of Timber is more certain than that of *Cleft-Pales*, for it has been found, that a Tun of Timber will make about 400 Foot of Inch Boards, (the Timber being of fit Length) being cut out

into	5 Foot	Pales, will make	80	Pales each a Foot broad;
	4 Foot		100	
	3 Foot		130	

which in Paleing will reach about three times as far as the like Number of Cleft Pales will do.

PALLISADE } PALLISADO } is a Sort of slight open Pale or Fence, set to beautify the Place, Walk; *&c.*

There is such Variety in the Workmanship of Pallisado Pales, that there can be no certain Price by the Rod.

Pallisado Gates are as various in their Forms and Fashions as Pallisado Pales, and consequently their Prices are also as various, *viz.* from 6 or 7 to 10 or 12 *s. per* Yard, running Measure at about 7 Foot high.

Iron Pallisado Work in Gates or otherways, is from 4 *d. per* Pound, to 8 *d.* according to the Work.

PALLIFICATION [in *Architecture*] is the pileing of the Ground Work; or strengthening it with Piles or Timber driven into the Ground; which is practis'd when they build upon a moist or marshy Soil.

PALLIER } PAILLIER } [in *Building*] is sometimes us'd for a Landing Place in a Stair Case; or a Step, which being broader than the Rest, serves to rest upon.

PANNEL [in *Joinery*, &c.] is a Tympanum or square Piece of thin Wood, sometimes carv'd, fram'd or grov'd in a larger Piece between two Montants or upright Pieces, and two Traverses or cross Pieces.

PANNELS or Panes of Glass are Compartiments or Pieces of Glass.

PANNEL [in *Masonry*] is one of the Faces of a hewn Stone.

PANNIER [in *Architecture*] See *Corbel.*

PANTHEON [in *Architecture*] is a Temple or Church of a Circular Form; dedicated to all the Gods, or all the Saints.

PANTRY, a Room to set Victuals in; a Store Room.

PAN-Tiles, See *Tiles.*

PARABOLA is a Curve, as E D F made by cutting a Cone by a Plane D G parallel to one of its Sides, as in the Figure; See *Plate*, Fig. 1,

PARABOLICK *Pyramidoid*, is a solid Figure, generated by supposing all the Squares of the Ordinates Applicates in

the Parabola, ſo plac'd as that the *Axis* ſhall paſs through all their Centres at Right Angles; in which Caſe, the Aggregate of the Planes, will be arithmetically proportional; whoſe Solidity is gain'd by multiplying the Baſe by half the Altitude.

PARABOLICK *Space*, is the Area contain'd between the Curve of the Parabola, and a whole Ordinate A B.

This is $\frac{2}{3}$ of the circumſcribing Parallelogram A C D B in the common Parabola; See the *Plate*, Figure 2.

PARABOLICK CUNEUS, is a Solid mention'd by Dr. *Wallis*, and is form'd thus; multiply all the D B s into the D S s, or which is all one upon the Baſe A F B erect a Priſm, whoſe Altitude ſhall be A S, and this ſhall be the Parabolick Cuneus, which is equal in Solidity to the *Parobolical Pyramidoid*; See the *Plate*, Figure 3.

PARABOLICK SPINDLE is a Solid made by the Relation of a Semi-Parabola about one of its Ordinates, and is equal to $\frac{8}{15}$ of its circumſcribing Cylinder.

PARABOLOIDES }
PARABOLIFORM *Curves* }
are Parabolas of the higher Kind.

PARALLEL [in *Geometry*] is a Term apply'd to Lines, Figures and Bodies, which being prolonged, are ſtill at equal Diſtance from one another.

PARALLEL *Planes* are thoſe Planes which have all the Perpendiculars drawn betwixt them, equal to each other; that is, when they are equally every where diſtant.

PARALLEL RULER is an Inſtrument of Wood, Braſs, &c. conſiſting of two Parallel Rules, which open and ſhut parallel to one another, and is of great Uſe in all Parts of Mathematicks, where many parallel Lines are to be drawn.

PARALLEL *Rays* [in *Opticks*] are thoſe that keep an equal Diſtance from the viſible Object to the Eye, which is ſuppos'd to be infinitely remote from the Object.

PARALLELISM is the Quality of a *Parallel*, or that which denominates it ſuch, or it is that whereby two Things, *v. gr.* Lines or Rays, become equi-diſtant from one another.

PARALLELOGRAM [in *Geometry*] is a Right Line, quadrilateral Figure, whoſe oppoſite Sides are parallel and equal.

1. The oppoſite Angles of all Parallelograms are equal to one another.

2. All Parallelograms that are between the ſame Parallel Lines, and on one and the ſame Baſe, are equal.

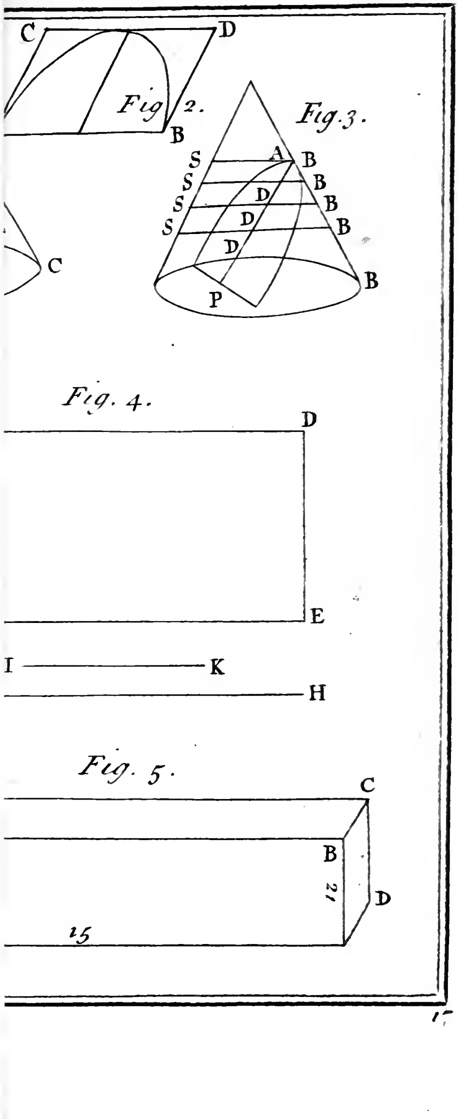
3. All Similar Parallelograms are to one another in the duplicate Ratio of their homologous Sides.

4. The Area of any Parallelogram is had by multiplying one of its Sides by a Perpendicular let fall from one of the oppoſite Angles.

PARALLELOGRAM, is alſo an Inſtrument made of five Rulers of Braſs or Wood, with

Sockets

Plate XVII.



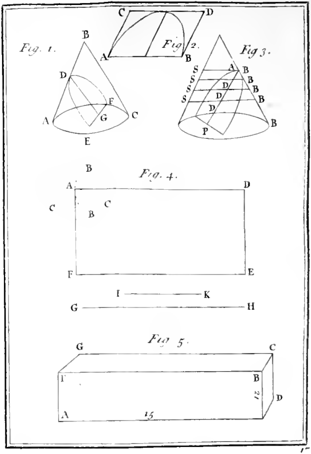


Fig. 1.
B
D
F
A
G
C
E
C
D
A
Fig 2.
B
Fig 3.
S
A
B
P
Fig. 4.
B
A
D
C
C
B
F
E
I
K
G
H
Fig 5.
G
C
F
B
21
D
A
15

Sockets to slide or set to any Proportion, us'd to enlarge or diminish any Map or Draught, either in Building, Surveying, &c.

To describe the oblong PARALLELOGRAM A D F E, whose Length shall be equal to the given Line G H.

First, make F C = to G H, and on E erect the Perpendicular E D = I K; then on D with the Radius G H, describe the Arch B B; and on the Point F with the Radius I K, describe the Arch C C.

Secondly. Join A F and A D and they will compleat the Oblong. See the *Plate*, Figure 4.

PARALLELOGRAMMICK PROTRACTOR, is a Semi-Circle of Brass, with four Rulers, in Form of a Parallelogram made to move to any Angle; one of which Rulers is an Index, which shews on the Semi-Circle, the Quantity of any inward or outward Angle.

PARALLELOPIPED [in *Geometry*] is a solid Figure contain'd under six Parallelograms, the opposite Sides of which are equal and parallel; or 'tis a Prism, whose Base is a Parallelogram, this is always triple to a Pyramid of the same Base and Height.

Let A B C D E F G be a Parallelopipedon or a square Prism, representing a square Piece of Timber or Stone, each Side of its Square Base A B C D, being 21 Inches, and its Length A E, 15 Foot.

First, then multiply 21 by 21, the Product is 441, the Area of the Base in Inches; which multiply'd by 180, the Length in Inches, and the Product is 79380, the Solid Content in Inches.

Divide the last Product by 1728, and the Quotient is 45.9, that is 45 Solid Feet and 9 Tenths of a Foot: Or thus, multiply 441 by 15 Feet, and the Product is 6615; divide this by 144, and the Quotient is 45 . 9, the same as before.

Or thus, by multiplying Feet and Inches.

Multiply 1 Foot 9 Inches, by 1 Foot 9 Inches, and the Product is 3 Feet 0 Inches, 9 Parts; this multiply'd again by 15 Feet, gives 45 Feet, 11 Inches, 3 Parts; that is 45 Feet, and $\frac{11}{12}$ of a Foot, and $\frac{1}{4}$ of $\frac{1}{12}$.

See the Work of all these.

21	441	F.	I.	
21	15	1	9	
		1	9	
21	2205			
42	441	1	9	
		1	3	9
441	144) 6615 (45 : 9			
180		3	0	9
	855	15		
35280	1350			
441		45	3	9
	54			

```
1728) 79380 (45 : 9
      6912
      ----
      10260
       8640
      -----
       16200
       15552
       -----
         648

     7      6
     3      9
  -----  -----
    45     11    3
```

By Scale and Compasses.

Extend the Compasses from 13 to 21, and that Extent will reach to near 46 Foot, being twice turn'd over from 15 Foot; so the Solid Content is almost 46 Feet.

If the Base of the Square solid, be not an exact Square; but in the Form of a Rectangled Parallelogram, the Way of measuring it is much the same; for first you must find the Area of the Base by multiplying the Breadth by the Depth, and then multiply that Area by the Length of the Piece, as before: thus,

If a Piece of Timber be 25 Inches broad, 9 Inches deep and 25 Feet long, how many solid Feet are contain'd therein?

```
   25          144) 5625 (39          F.    I.
    9               432               2     1
  ----              ----              0     9
  225               1305             ----------
   25               1296              1     6  9
  ----              ----              25
 1125                 99             ----------
 450                                 25  :  0  0
 ----                                12  :  6  0
 5625        Answer 39 Feet.          1  :  0  6
                                      0  :  6  3
                                     ----------
                                     39  :  0  9
```

By Scale and Compasses

First, Find a mean Geometrical Proportional between the Breadth and the Depth; which to do upon the Line of Numbers, you must divide the Space upon the Line between the Breadth and the Depth into two equal Parts; that middle Point will be the mean Proportional sought: Thus the middle Point between 25 and 9 is at 15: So is 15 a mean Proportional between 9 and 25: for 9 : 15 : : 15 : 25; so a Piece of Timber 15 Inches square is equal to a Piece 25 Inches broad, and 9 Inches deep.

So then if you extend the Compasses

Compasses from 12 to 15, that Extent turn'd twice over from 25 Feet; the Length will reach to 39 Feet, the Content. See *Plate*, Figure 5.

PARALLELOPLEURON [with some *Geometricians*] is a Word us'd to signify an imperfect Parallelogram, or a kind of *Trapezium*, having unequal Angles and Sides, yet not also in regard that at least some of them answer to one another, observing a certain Regularity and Proportion of Parallels; so that they do not extend so largely as *Trapeziums*, which are any irregular four sided Figures; nevertheless like them they are capable of being variously diversified.

PARAMETER [in *Geometry*] a constant Right Line in several of the Conic Sections, call'd also *Latus Rectum*.

PARASTATA [in the ancient *Architecture*] an Impost or kind of *Anta* or *Pilaster*, built for the Support of an Arch, or as some will have it, Pilasters which stand alone, not adjoining to the Wall. *Daviler* makes Parastata the same as *Impost*; but *Evelyn*, the same as *Pilaster*.

PARAPET [of the *Italian* *Parapetto*, a save-Breast] is a little Wall, or sometimes a Rail, serving either as a *Rest* for the Arm, or as an Inclosure about a Key, Bridge, Terras, &c.

PARGETING [in *Building*] is us'd for the plaistering of Walls; sometimes it is us'd to signify the Plaister it self.

As to the various Kinds, &c.

1. With Lime, Hair and Mortar laid upon bare Walls, at 3 *d.* or 4 *d.* the Yard.

2. Upon bare Laths, as in Partitioning and plain Ceilings from 8 *d.* to 14 *d.* *per* Yard.

3. Rendring the Insides of Walls, or doubling Partition Walls, at 2 *d.* or 3 *d.* *per* Yard.

Rough casting upon Heart-Laths, from 1 *s.* to 3 *s.* *per* Yard, Workmanship, and all Materials.

5. Plaistering upon Brick-Work, with finishing Mortar in Imitation of Stone Work, from 1 to 2 *s.* *per* Yard Square.

6. The like upon Heart-Laths, from 18 *d.* to 2 or 3 *s.*

PARLOUR, a fair lower Room design'd principally for the Entertainment of Company.

Aliquant PART, is a Quantity, which being repeated any Number of Times, becomes always either greater or less than the whole; thus 5 is an Aliquant Part of 17, and 9 an Aliquant Part to 10.

Aliquot PART, is a Quantity which being repeated any Number of Times, becomes equal to the whole.

PASS-PAR-TOUT; a master Key or Key that opens indifferently several Locks, belonging to the same Lodge or Apartment.

PASSAGE, an Entry or narrow Room, serving only for a thoroughfare or Entrance into other Rooms.

PATER-NOSTERS [in *Architecture*] are certain Ornaments plac'd underneath the

Ovolo's, cut in the Form of Beads, round or Oval.

PAVEMENT a Lay of Stone or other Matter, serving to cover and strengthen the Ground of divers Places for the more commodious walking on.

In some Places, as in *France*, the publick Roads, Streets, Courts, &c. are pav'd with *Gres*, a kind of Free Stone.

In *Venice*, the Streets, &c. are pav'd with Brick; Churches sometimes with Marble, and sometimes with Mosaic Work, as the Church of St. *Mark*, at *Venice*.

In *Amsterdam* and the chief Cities of *Holland*, they call their Brick Pavement, the *Bourgher Masters Pavement*, to distinguish it from the Stone or Flint Pavement, which is usually in the middle of the Street, serving for the Passages of their Horses, Carts, Coaches and other Carriages; the Brick Borders being design'd for the Passage of People on Foot.

In *England* the Pavement of the Grand Streets, &c. are usually Flint or Pebbles, Courts, Equerries, Kitchins, Halls, Churches, &c. are usually Tiles, Bricks, Flags or Fire-Stone; sometimes a kind of Free-Stone and Rag-Stone.

Pavements of Free-Stone, Flint and Flags in Streets &c. are laid dry, *i. e.* are retained in a Bed of Sand, those of Courts, Equerries, Ground Rooms, &c. are laid in a Mortar of Lime and Sand, or in Lime and Cement, especially if there be Vaults or Cellars underneath.

Some Masons after laying a Floor dry, especially of Brick, spread a thin Mortar over it, sweeping it backward or forwards, to fill up the Joints.

PAVEMENT *of a Terras*, is that which serves for the Covering of a Platform, whether it be over a Vault, or on a wooden Floor.

Those over Vaults, are usually Stones squared and bedded in Lead.

Those on Wood are either Stones with Beds for Bridges; Tiles for Ceilings in Rooms, or Lays of Mortar made of Cement and Lime with Flints or Bricks, laid flat, as is still practis'd by the Eastern and Southern People, a Top of their Houses.

PAVING is the Laying a Floor with Stones, Bricks or Tiles.

Paving or laying with *Free-Stones*, *i, e.* with broad Stones, taken out of the Quarrys, and cut into Lengths and Breadths promiscuously (as they will hold, and in Thickness about two or three Inches, is usually reckon'd at 6 *d.* 7 *d*, or 8 *d.* the Foot square, or 4 *s.* 6 *d.* 5 *s.* 3 *d.* and 6 *s.* the Yard Square, for Stone and Workmanship.

This kind of Paveing is laid in common Yards and Passages, before Shop Doors, Stalls, &c.

But if the Stones be squared all to a Size (as sometimes these Stones are cut perfectly square, as paving Tiles are; but much larger, as 18, 20 and 24 Inches Square and upwards) then as they are neater, so they

they are dearer, as 12 *d.* or 14 *d.* *per* Foot, or 9 *s.* or 10 *s.* 6 *d.* *per* Yard.

But if the Stones thus ſquar'd and ſiz'd be good and well poliſh'd (as they ought to be for Kitchins, Dairies and neat Places) then they may be worth 15 or 16 *d. per* Foot, or 11 *s.* 3 *d.* or 12 *s.* *per* Yard ſquare.

Paving with Rigate Stones]. This kind of Pavement is good for Chimney Fire Hearths, Ovens, Stoves, *&c.* and it is ſometimes dearer than common *Purbeck* Pavement. See *Fire Stone.*

Paving with Marble is of all other the moſt beautiful, of which there are ſeveral Sorts, as white, black and grey: Some Pavements (as of Foot Paces before Chimneys) are laid all of one Sort or Colour, and in one intire Stone; others of two Colours, laid ſquare or checquer Ways; the Side of the one, by the Side of the other; others are laid Arrace-wiſe of two Colours, laid Angle to Angle, and this laſt is the neateſt Way.

But there may be divers Forms contriv'd to lay them in, as may be ſeen in ſeveral Chancels, in the Choir of St. *Pauls*, and the *Royal Exchange* in *London*, and divers other Places.

This Sort of Pavement is valued from 2 to 3 *s.* *per* Foot ſquare and upwards according as 'tis well laid and poliſh'd. See *Marble.*

Paving with Rough or Rag Stone, is the cheapeſt of all Pavements, and is valued from 15 to 18 *d.* *per* Yard.

Paving with Statute Bricks. This is done at *London* for about 4 *d. per* Yard.

But it is ſaid, that a Workman has in *Suſſex* 5 or 6 *d. per* Yard; but then into this Price they make ready the Floor for the Work; by clearing out the Earth, and levelling the Floor with a convenient Quantity of Sand (if they lay the Bricks dry, as ſometimes they do) which they ſpread evenly with a Rake) then laying the Bricks level by a Line, they with a Trowel put a ſufficient Quantity of Sand under each Brick, to raiſe it full as high as (or a little higher than) the Line, and ſo knock it down level with the Line, with the Handle of their Hammer, which when they have done, they ram in the Sand (on the Side of, and) againſt the Bottom of the Brick, with the Handle of their Hammer, to make it lie faſt.

The whole Floor being laid after this Manner, they ſtrew Sand all over the Bricks, to the Thickneſs of an Inch, and order the People of the Family to let it lie ſo for five or ſix Weeks, only ſweeping it to and fro' now and then; that thereby, and by Means of their treading on it, it may fill up all the Joints between the Bricks.

If the Bricks are laid in Mortar, the Price is much the ſame as if they were laid dry.

There are ſome Maſons who when they have laid the Floor dry,

dry, will ſpread the Floor all over with very thin Mortar, and ſweep it to and fro' with a Broom, to fill up the Joints of the Bricks.

This Sort of Paving (with common Statute Bricks) is uſual for Cellars, Waſh-Houſes, Sinks, Fire-Hearths, and for Halls and Kitchins in common Houſes.

32 of theſe Bricks will pave a Yard ſquare, if laid flat ways; and 64, edge ways.

Paving with ſquare Tiles, or as they are call'd by ſome, Paving Bricks.

The Paving with ſquare Tiles, is commonly valued by the Square, and by how much the Tiles are the ſmaller, by ſo much the dearer.

Theſe Tiles are of ſeveral Sizes, *viz.* 6, 8, 10 and 12 Inches ſquare; their Price from 6 to 20 *s. per* Hundred.

In *Suſſex*, 9 Inch Tiles are ſold for 1 *d. per* Tile or 8 *s. per* Hundred.

If you would know how many of either of theſe Sort of Tiles will pave any Floor,

Note that	36	Tiles of	6	Inches ſquare, will pave a ſquare Yard.
	21		8	
	16		9	
	13		10	
	9		12	

Paving with Flemiſh Bricks] The Paving with theſe Bricks, is far neater and ſtronger than common Bricks. The Colour of them is a dirty yellow, and they muſt be laid in Sand. Theſe Bricks are ſix Inches and a quarter long, two Inches and a half broad, and one Inch and a quarter thick.

Now allowing a quarter of an Inch for the Joint, then 72 of them will pave a Yard ſquare; but if they be ſet edgeways, then it will require 100 Bricks to pave a Yard ſquare.

Theſe Bricks are uſually ſold at 2 *s.* the Hundred, and the Price of laying them is 4 *d.* 5 *d.* or 6 *d.* the ſquare Yard.

Diamond Pavement, Mr. *Wing* ſays is worth 3 *d.* or 4 *d. per* Foot.

Random Pavement.] This Mr. *Wing* ſays at the Quarry, is worth 2 ½ *d.* or 3 *d per* Foot.

Of the meaſuring of a Pavement.] This is commonly meaſured by the Yard ſquare.

Therefore take the Length of any Pavement in Feet and Inches, and multiply it by the Breadth in Feet and Inches, by *Croſs Multiplication*, which ſee, and the Product will be the Content in Feet; which being divided by 9 (becauſe 9 ſquare Feet make a ſquare Yard) will give the Content in Yards requir'd.

PEDIMENT [in *Architecture*] is a kind of low Pinnacle, ſerving to crown an Ordnance, or finiſh a Frontiſpiece, and is plac'd as an Ornament over Gates, Doors, Windows, Niches, Altars, *&c.* it is ordinarily

rily of a triangular Form; but ſometimes makes an Arch of a Circle.

Vitruvius obſerves that the Pinnacles of the plaineſt Houſes, gave Architects the firſt Idea of this noble Part, which ſtill retains the Appearance of its Original.

The Parts of a Pediment are the *Tympanum* and the *Corniche*.

The firſt is the Pannel, naked or Area of the Pediment, inclos'd between the Corniche which crowns it, and the Entablature which ſerves it as a Baſe or Socle.

Architects have indeed taken a great Deal of Liberty as to the Form of this Member.

The moſt beautiful according to *Daviler*, is where its Height is about $\frac{1}{5}$ of the Length of its Baſe.

Vitruvius calls the Pediment *Faſtigia*, which ſignifies a Roof rais'd or pointed in the middle, which Form among the *Romans*, was peculiar to Temples.

All their Dwelling Houſes are cover'd in the Platform Manner; and it is obſerv'd by *Salmaſius* on *Solin*, that *Cæſar* was the firſt who obtain'd Leave to Roof his Houſe with a Ridge or Deſcent, after the Manner of Temples.

The *Pediment* is uſually triangular, and ſometimes an equilateral Triangle, call'd alſo a *pointed Pediment*, it is ſometimes circular, tho' it has been obſerv'd by Mr. *Felibien*, that we have no Inſtance of round Pediments in the antique, beſides thoſe in the Chapels of the *Rotundo*.

Sometimes its upper Corniche is divided into three or four Sides or Right Lines. Sometimes the Corniche is cut or open a Top, which is an Abuſe introduc'd by the Moderns, particularly *Michael Angelo*; for the Deſign of this Part at leaſt over Doors, Windows, &c. being chiefly to ſhelter thoſe underneath from the Rain; to leave it open in the middle, is to fruſtrate its Ends.

Sometimes the Pediment is form'd of a couple of Rolls or Wreathes like two Conſoles join'd together.

Sometimes the Pediment has no Baſe, or its lower Corniche is cut out, all but what is beſtow'd on two Columns or Pilaſters, and on theſe is rais'd an Arch or Sweep, inſtead of an Entablature; of which *Serlio* gives an Inſtance in the Antique in a *Corinthian* Gate at *Foligni* in *Umbria*; and *Daviler*, a modern one, in the Church of St. *Peter* at *Rome*.

Under this kind of Pediments, come thoſe little arch'd Corniches, which form Pediments over Doors and Windows, ſupported by two Conſoles, inſtead either of Entablature or Columns.

Sometimes the Pediment is made double, *i. e.* a leſs Pediment is made in the Tympanum of a larger, on Account of ſome Projecture in the middle, as in the Frontiſpiece of the Church of the great *Jeſus* at *Rome*: But this Repetition

is accounted an Abuſe in Architecture, altho' it be authoriz'd by very good Buildings, as the large Pavilion of the *Louvre*, where the *Caryatides* ſupport three Pediments one in another.

Sometimes the Tympanum of the Pediment is cut out, or left open to let in Light, as is ſeen under the Portico of the Capitol at *Rome*.

Laſtly this open Pediment is ſometimes triangular, and enrich'd with Sculpture, as Roſes, Leaves, *&c.* as is found in moſt of the *Gothic* Churches.

M. *Le Clerc* obſerves, that the Modillions in the Corniche of the Pediment, ſhould always anſwer exactly over thoſe of the Entablature.

Indeed *Vitruvius* ſays, the Ancients did not allow any Modillions at all in Pediments.

M. *Le Clerc* alſo obſerves, that the Corniche which ſerves the Pediment as a Baſe, ſhould have no Cymatium, by Reaſon the *Cymatium* of the Reſt of the Entablature when it meets the *Pediment*, paſſes over it.

This Change of Determination occaſions a conſiderable Difficulty; the *Cymatium* in this Caſe, appearing too broad in the Turn of the Angle; to remedy which, Architects have Recourſe to ſeveral Expedients.

A *pointed Pediment* may crown three Arches; but a *circular Pediment*, can only crown agreeably.

There ſhould never be us'd more than two *Tympana* over each other in the ſame Frontiſpiece; and even where there are two, it would be proper to have the lower circular, and the upper, pointed.

PEDESTAL [in *Architecture*] is the loweſt Part of an Order of Columns; being that which ſuſtains the Column and ſerves it as a Foot or Stand.

The Pedeſtal which the *Greeks* call *Stylobates* and *Stereobates*, conſiſt of three principal Parts, *viz.* a *Square*, *Trunk*, or *Die*, which makes the Body; a *Corniche*, the Head; and a *Baſe* the Foot of the Pedeſtal.

The Pedeſtal is properly an Appendage to a Column, not an eſſential Part of it; thô M. *Le Clerc* thinks it is eſſential to a compleat Order.

There are as many kind of Pedeſtals, as there are of Orders of Columns, *viz.* 5. The *Tuſcan*, *Doric*, *Ionick*, *Corinthian* and *Compoſite*.

Some ſay the Height of the Pedeſtal in each Order, ought to be a third Part of the whole Column, comprehending the Baſe and Capital, and their upper Adjuncts as Architrave, Frieze and Corniche, a fourth Part of the ſame Pillar.

The *famous* Engliſh Architect, Sir *Henry Wootton* ſays, he finds this Rule of ſingular Uſe and Facility, ſettled by *Jacobo Barozzio*, whom he eſteemed a more credible Author than others (as a Man that moſt intended this Piece of Architecture) than any that vary from them in theſe Dimenſions.

Indeed *Vignola* and moſt of the

the Moderns make the Pedestal and its Ornaments in all the Orders, one third of the Height of the Column, including the Base and Capital, but some deviate from this Rule.

M. *Perrault* indeed, makes the Proportions of the three constituent Parts of *Pedestals*, the same in all the Orders, *viz.* the Base or Socle one fourth of the *Pedestal*, the Corniche an eighth Part, and the Socle or Plinth of the Base, two thirds of the Base it self. The Height of the Die, is what remains of the whole Height of the *Pedestal*.

Tuscan Pedestal (according to *Vitruvius*) the whole Height of the *Tuscan* Column comprehending the Architrave Frieze and Cornice is divided into Nine Parts, two of which go to the Height of the Pedestal.

This Pedestal is by him describ'd in two different *Forms*, one of which is plain, having only a Plinth for the Base, and another for the Capital; the Height of each of those Plinths is $\frac{1}{6}$ of the whole Height of the Pedestal, and the Projecture of these Plinths is $\frac{1}{6}$ of their Height.

In the *Pedestal* that he describes, of the other Form he also divides the whole Height of the Pedestal into six Parts, one of which goes to the Base, and one to the Capital.

And again he divides the Base into two Parts, one of which goes to the Plinth below, and the other to the Rest of the Base; this is also subdivided into four Parts, and three of them goes to the *scima reversa*, and the List below it which is $\frac{1}{2}$ a Part, and the other to the List above it.

Palladio and *Scamozzi* make the *Tuscan Pedestal* three Modules high; *Vignola* Five.

Its Members in *Vignola* are only a *Plinth* for a Base, the *Die*, and a *Talon* crowned for a Corniche; the Tuscan Column has rarely any.

The *Dorick Pedestal. Vitruvius* divides the whole of this Column (comprehending the Architrave, Frieze and Corniche) into eight Parts, two of which go to the Height of the Pedestal, which agrees with *Jacobo Baroccio*'s Rule.

Vitruvius also describes this Pedestal in two different Forms; in both of which, the Base and Capital are each $\frac{1}{7}$ of the whole Height of the *Pedestal*.

He divides the Base of one of the fashioned Pedestals into two Parts, one of which goes to the Plinth below, and the other to the rest of the Base: and this Part being again sub-divided into two Parts, one of them makes the lower *Thorus*; and the other is sub-divided again into three Parts, two of which go to the upper *Thorus*, and the other to the List above it.

The *Capital* of the *Pedestal* of this Fashion is divided into 4 Parts, the lowermost of which makes the *Astragal* (whose List is $\frac{1}{3}$ of the whole Astragal, and the other three Parts go to the *Cymatium*, the List of which at the Top, is one of these Parts.

The Height of the Base of the Pedestal of the other Fashion is

is alſo divided into two Parts, the lowermoſt of which goes to the Plinth, and the other Part being again ſub-divided into three Parts, two of them make the *Thorus*, and the other Part of the Liſt above it.

The whole Height of the Capital of the Pedeſtal of this Faſhion is divided into five Parts, the lowermoſt of which goes to the *Aſtragal*. (Whoſe Liſt is $\frac{1}{3}$ of the whole,) the next two Parts go to the *Ogee*, and the two Parts that remain are ſub-divided into three Parts, the lowermoſt of which go to the Square, and the other to the *Cymatium*, whoſe Liſt is $\frac{1}{3}$ of the whole.

Palladio makes the *Dorick Pedeſtal* four Modules five Minutes high, *Vignola* 5 *Modules* four Minutes.

In the Antique, we not only dont meet with any Pedeſtal; but even not with any Baſe in the *Dorick* Order.

The Members of *Vignola*'s, *Dorick Pedeſtal* are the ſame with thoſe of the *Tuſcan*, with the Addition of a Mouchette in its Corniche.

The *Ionic* Pedeſtal. The whole Height of this Column being divided into fourteen Parts, the Height of its Pedeſtal (according to *Vitruvius*) is three of theſe Parts.

He alſo deſcribes this Pedeſtal in two different Forms, the Baſe and Capital of each of which are each $\frac{1}{3}$ of the whole Height of the Pedeſtal.

He divides the Height of the Baſe of one of theſe faſhionent Pedeſtals, into three Parts, the lowermoſt of which goes to the *Plinth*, the next to the *ſcima reverſa*, with its Liſt at Top and Bottom, which are each $\frac{1}{6}$ of the whole; the uppermoſt Grand Diviſion being ſub-divided into two, the lowermoſt of them goes to the *Caſement* or *Hollow*, with its Liſt at the Top, which is $\frac{1}{5}$ of the whole: The other Part goes to the *Thorus*: And its Liſt above it, which Liſt is $\frac{1}{3}$ of the whole. The Capital of the Pedeſtal of this Faſhion is divided into two Parts, the lowermoſt of which goes to the *ſcima reverſa*, with its Liſt above and below it: The lower Liſt is $\frac{1}{4}$ of the whole, and the upper Liſt $\frac{1}{6}$ of the Remainder. The other Grand Diviſion being ſub-divided into three Parts, the two lowermoſt of them go to the Square, and the other to the *Cymatium*, the Liſt of which is $\frac{1}{3}$ Part of the whole *Cymatium*.

In the Pedeſtal of the other Faſhion, the Baſe is alſo divided into three Parts, the lowermoſt of which goes to the Plinth, the other two Grand Diviſions are again divided into Five, and the three lowermoſt of them go to the *ſcima reverſa*, and the Liſt under it, which Liſt is $\frac{1}{6}$ of the whole; the other two Diviſions are again ſub-divided into three Parts, the two Lowermoſt of which go to the *Thorus*, and the remaining Part to the Liſt above it.

The *Capital* of the Pedeſtal of this Faſhion is divided into two Parts, the lowermoſt of which being ſub-divided into four Parts, the lowermoſt of them

them goes to the Aſtragal (of which its Liſt is $\frac{1}{3}$ Part) the other three of thoſe ſub-diviſions go to the *ſcima reverſa*, and its Liſt above it, which Liſt is $\frac{1}{6}$ of the whole; the other Grand Diviſion is alſo ſubdivided into three Parts, the two lowermoſt of which go to the Square, and the other Part to the Aſtragal whoſe Liſt is $\frac{1}{3}$ of the whole.

According to *Vignola* and *Serlio*, the *Ionic* Pedeſtal is ſix Modules high; according to *Scamozzi*, Five; in the Temple of *Fortuna Virilis*, it is ſeven Modules twelve Minutes.

Its Members and Ornaments are moſtly the ſame with thoſe of the *Doric*, only a little richer.

The Pedeſtal now uſually follow'd is, that of *Vitruvius*, altho' it is not found in any Work of the Antique.

Some, inſtead of it, uſe the *Attick* Baſe in Imitation of the Antients.

The Corinthian Pedeſtal. Vitruvius divides the whole Height of this Column into Nine Parts, and makes the Height of this Pedeſtal two of thoſe Parts.

The whole Height of the Baſe being divided into five Parts, the two lowermoſt of them go to the *Plinth*; then the Remainder is again ſubdivided into four Parts; the lowermoſt of which goes to the *Thorus*; and the two next Parts make the *ſcima reverſa*, and the Liſt below it, which Liſt is $\frac{1}{3}$ of the whole; the remaining Part goes to the Aſtragal, the Liſt of which is $\frac{1}{3}$ Part.

The Height of the Capital is divided into two Parts, the lowermoſt of which being ſubdivided into four Parts, the lowermoſt of thoſe go to the *Ogee*. The other three Subdiviſions being again ſubdivided into two Parts, the lowermoſt of thoſe goes to the *Scotia* or *Hollow*, and the Liſt above it, which Liſt is $\frac{1}{3}$ Part of the whole, and the remaining Part goes to the Boullin.

The other Grand Diviſion is alſo ſubdivided into three Parts, of which the two lowermoſt go to the *Corona*, and the remaining Part to the *Cymatium*, the *Liſt* of which is $\frac{1}{3}$ of the whole.

The *Corinthian Pedeſtal* is the richeſt and moſt delicate. In *Vignola*, it is ſeven Modules high; in *Palladio* five Modules one Minute. *Vignola* makes it ſeven Modules high; in *Palladio* five Modules one Minute; *Serlio* ſix Modules fifteen Minutes: it is in the *Colliſeum*, four Modules two Minutes.

Its Members, according to *Vignola*, are as follows; in the Baſe are a *Plinth* for a *Socle*, over that a *Tore* carv'd; then a *Reglet*. A *Gula* inverted and inrich'd; and an *Aſtragal*.

In the Die are a *Reglet*, with the *Conge* over it, and near the *Corniche* a *Reglet* with a *Conge* underneath.

In the *Cornicke* is an *Aſtragal*, a *Frieze*, *Fillet*, *Aſtragal Gorge*, *Talon* and a *Fillet*

The Compoſite. Pedeſtal Vitruvius divides the whole Height of this Column into thirteen Parts, making the Height of its Pedeſtal three of thoſe Parts.

The Base he divides into 7 Parts, two of which go to the *Plinth*, one to the *Thorus*, two to the *scima reversa*, one to the *Scotia*, and one to the *Astragal*; $\frac{1}{3}$ of the *Astragal* makes the *Fillet* above the *Scotia*.

The Capital he divides into seven Parts, one of which goes to the *Astragal*, two to the *Frieze*, one to the *Boultine*, and Lift under it; two to the *Corona*, and one to the *Cymatium*.

Vignola makes the *Composite Pedestal* of the same Height with the *Corinthian*; *viz.* seven Modules, *Scammozzi* six Modules 2 Minutes; *Palladio* six Modules seven Minutes. In the Gold-Smith's Archs, seven Module eight Minutes.

Its Members in *Vignola* are the same with those of the *Corinthian*: but with this Difference, that whereas these are most of them inrich'd with Carvings in the *Corinthian*, they are all plain in the *Composite*.

And there is also a Difference in the Profiles of the Base and Corniche in the two Orders.

Daviler observes, that the Generality of Architects use Tables or Pannels either in *Relievo* or *Creux*, in the Dies of Pedestals; without any Regard to the Character of the Order.

Those in *Relievo*, he observes, are only suitable to the *Tuscan* and *Doric*; the three others must be indented, which he says, is a Thing the Ancients never practis'd, as being contrary to the Rules of Solidity.

Pedestal of the *Ionic* Order. The Height of this Pedestal, according to this general Rule already propos'd, should be one third of the Shaft of the Column; that is it should exceed 4 Modules 20 Minutes: Yet M. *Le Clerc* says he makes it five Minutes more; without which, in his Opinion, it would lose all its Beauty; whence says he, it may be observ'd, that general Rules are not always to be rigidly follow'd.

The Breadth of the Pedestal he means that of the Die, is always, he says, equal to the Breadth of the Plinth of the Column; excepting the Pedestal be without Base and Cornice, as it frequently happens. In which Case it is necessary that it should be a small Matter broader, in Order to distinguish it from the Base of the Column.

He usually allows one Module for the Height of the Base of the Pedestal, and half a Module for that of the Cornice; the Breadth of the Plinth of the Column, always determines that of the Die of the Pedestal; and a third of the Height of the Column, is the Measure for the whole Height of the Pedestal; so that the Difference in Height, between the Pedestals of his Orders, lies wholly in their Dies.

M. *Le Clerc*, proposes two kinds of Cornices for the *Pedestal* of the *Ionic* Order; the one camus and solid, to be us'd within Sides of Apartments, where the Pedestal is to be view'd

view'd from above: The other has a Larmier, and is intended for thoſe Pedeſtals, whoſe Cornices are above the Eye, and are to be view'd from below.

He obſerves, that were an *Aſtragal* to be plac'd underneath the Cornice of the Pedeſtal, he gives in his 41 Figure, as is done in that of his *Corinthian*, there ſhould be no Table in the Die; at leaſt if for any particular Reaſon there were requir'd one, there muſt be no *Aſtragal*.

Nor would I, ſays he, ever allow an Aſtragal under a Cornice, that is camus, and without a Larmier, but a Table hollow'd in the Manner of half this Pedeſtal.

A Table under the Aſtragal would make too many little Mouldings one over another; and the Projecture of an Aſtragal under a Cornice without a Larmier, would make it appear too camus; whereas the Retreat of a Table will give it a Grace, and ſeem to augment its Projecture, and render it leſs camus.

When Columns are to be plac'd two by two, as it is ſometimes found neceſſary, the regular placing of the Triglyphs in the inner Angle muſt be a little interrupted, in Order to keep up the Regularity of the Parts of the Ceiling, and inſtead of a little Part of a Triglyph in the Angle, may be plac'd ſome ſuitable Ornament to cover the Defect, as the Arms of a Family, *&c.*

Square PEDESTAL, is one whoſe Height and Width are equal; as that of the Arch of the Lions at *Verona*, of the *Corinthian* Order; and ſuch ſome Followers of *Vitruvius*, as *Serlio*, *Philander*, &c. have given to their *Tuſcan* Orders.

Double PEDESTAL, is that which ſupports two Columns, and has more Breadth than Height.

Continued PEDESTAL, is one which ſupports a Row of Columns without any Break or Interruption; as thoſe are which ſuſtain the fluted Columns of the Palace of the *Tuilleries*, on the Garden Side.

PEDESTALS *of Statues*, are ſuch as ſerve to ſupport Statues or Figures.

Vignola has obſerv'd, that there is no Part of Architecture more Arbitrary, and in which more Liberty may be taken, than in the Pedeſtals of Statues; there being no Rules or Laws preſcrib'd by Antiquity, nor any ſettled, even by the Moderns.

There is no ſettled Proportion for theſe *Pedeſtals*; but the Height depends on the Situation and the Figure that they ſuſtain; but yet when on the Ground, the *Pedeſtal* is uſually two thirds, or two fifths of that of the Statue; but the more maſſive the Statue is, the ſtronger the Pedeſtal muſt be.

Their Form and Character, *&c.* are to be extraordinary and ingenious, far from the Regularity and Simplicity of the Pedeſtals of Columns.

The ſame Author gives a great Variety of Forms, Oval, Triangular, Multangular, *&c.*

PEDIMENTS, ſays M. *Le Clerc*, are the Crowning frequently ſeen over Gates, Doors, Windows and Niches, and ſometimes over intire Orders of Architecture. The Ridges of ordinary Houſes were what gave Architects the firſt Idea of this noble Part.

The Parts of the Pediment are the *Tympanum* and its *Cornice*.

By *Tympanum* is meant the Area or Space included between the Cornice which crowns it, and the Entablature which ſupports and ſerves it as a Foundation.

The *Tympanum* is either triangular or circular; the Triangular, the Workmen call Pointed, and the Circular, Arch'd.

He obſerves, that the naked of a Pediment, *i. e.* the *Tympanum*, ought always to ſtand perpendicularly over the Frieze of the Entablature underneath.

2. That the Modillions of the Cornice of the Pediment ought to be ſound in the ſame Perpendicular, with thoſe of the Entablature underneath.

3. That Part of the Corniche on which the Pediment ſtands, beginning juſt at the Angle of the Corniche, as one would imagine it ſhould, it would be conſiderably widen'd, by Reaſon that that Angle is acute. But this would be a conſiderable Eye Sore; both on Account of the Inequality of its Width, and becauſe it would be rendred too ſtrong and heavy for the Corona.

Some Architects, to reduce this Cymatium to a proper Width, make the horizontal Cymatium that ſupports the two Sides of the Pediment very flat; but this is to prevent one Deformity, by putting another in its Stead.

Other Architects make a little Retreat or Elbow, as the Workmen call it, at the Extremity of the *Cymatium* of the Pediment; which Expedient, he thinks, is preferable to any of the reſt.

Sometimes the Pediment does not commence from the Extremity of the Corniche; but in that Caſe too there are Difficulties.

Vitruvius obſerves, that the Ancients did not approve of Modillions in the Corniche of a Pediment; and the Reaſon they gave for it was, that Modillions being only intended to repreſent the Ends of Rafters, it would be abſurd to uſe them in the Declivity of a Pediment, where no Rafters are ſuppos'd to be.

But the Truth in thoſe Modillions are rather Ornaments to ſuſtain the great Projecture of the *Corona* or *Larmier*, than to repreſent the Ends of any Rafters or Pieces of Wood; and therefore it would be a Weakneſs to be influenc'd by ſuch imaginary Reaſons; the rather, becauſe theſe Ornaments have a very good Effect, eſpecially when us'd in large Pediments.

M. *Le Clerc* obſerves, that a triangular Pediment may ſerve to crown three Arches, but a circular Pediment can't properly crown more than one; and

and the Centre of the Sweep of the Gate or Arch, ſhould be us'd for deſcribing the Sweep of the Pediment.

He would not have more than two Pediments plac'd over each other in the ſame Front of a Building; and even where there are two, it would not be amiſs to have the one with a Sweep, and the other pointed or triangular; this laſt finiſhing the Front in manner of a Ridge.

He alſo obſerves, that now we uſe none of thoſe broken and interrupted Pediments, which *Michael Angelo* introduc'd in his Time; nor is there any Body that ſeems to value them, but People of no Taſte or Experience.

Thoſe made of latter Days, and which are ſupported by an Entablature, truncated in the middle, as thoſe in the Court of the *Val de Grace*, were ſo maim'd to ſhew the Cypher of the Houſe. But theſe are alſo Corruptions in Architecture, which ought by all Means to be avoided.

He alſo obſerves, that tho' the Pediment is bounded by its *Tympanum* and its *Cornices*, yet were it not for its Entablature underneath, it would not only be ill ſupported, but imperfect too; juſt as a Ridge would be, if the Rafters that compoſe it, wanted Beams, to prevent their flying aſunder.

The placing of two Pediments over one another, as is done in the old *Louvre*, is perfectly abſurd and ridiculous, tho' perform'd by an Architect of Reputation.

In ſome Places we likewiſe ſee the Architrave interrupted and cut off between the two Columns with Feſtoons in its Place, which is a Deformity, tho' ſomewhat leſs conſiderable than the former.

He alſo remarks, that *Vitruvius* thinks it juſt, that all the Parts rais'd above Columns and Pilaſters, that is, all that are above the Eye, as the Faces of the *Architrave*, the *Frieze* the *Tympanum* of the *Pediment*, the *Acroteria* with their Figures or Statues, ſhould be inclin'd forward, about a twelfth Part of their Height. And his Reaſon for it is, that thoſe Parts will by that Means be the better expos'd to the View of ſuch Perſons who are plac'd below; but he thinks his Advice ought here to be ſet aſide, as being built on a particular Reaſon, to the Prejudice of a general Rule, which enjoins all the Parts of a beautiful Building to be exactly perpendicular. Without this, he ſays, they muſt needs have a woful Effect, when view'd Sideways; on which they would appear Reeling, and ready to tumble down.

However, Statuaries obſerve *Vitruvius*'s Maxims very judiciouſly, with reſpect to their Figures, when they are plac'd ſufficiently high, and can only be view'd in Front, and from below.

PEER } [in *Building*] is a
PIER } maſſive of Stone, &c. oppos'd by Way of Fortreſs againſt the Force of the Sea, or a great River; for the Security of Ships that lie at Har-

Harbour in any Haven, as *Dover Peer*, the *Peer* at great *Yarmouth*, &c.

PEERS [in *Architecture*] are a kind of Pilasters or Buttresses, rais'd for Support, Strength, and sometimes for Ornament.

Peers, are a Sort of square Pillars, part of which is hid within the Wall; the only Thing wherein it differs from a Pilaster, being this, that the latter has a Base and Capital, which the former has not.

The Scantlings or Size of Peers.] The Scantlings of Stone Peers, set down by Act of Parliament for the rebuilding of the City of *London*, after the Fire in 1166, (which Scantlings were well consider'd by able Workmen, before they were reduc'd into an Act) to be as follows, *viz.* in the first Sort of Houses, *Corner Peers* 18 Inches square; *middle* and *single Peers*, 12 and 14 Inches; *Double Peers* between House and House, 14 and 18 Inches. In the second and third Sort of Houses, *Corner Peers* 2 Foot 6 Inches square; *middle* or *single Peers*, 18 Inches square; *Double Peers* between House and House, 14 and 19 Inches square.

The Price.] Peers are sometimes measured and rated by the Foot running Measure; but they are more commonly rated at so much *per* Piece, dearer or cheaper, according to their Size, Goodness of the Stuff, and Curiosity of Workmanship.

A Pair of Stone Peers with Seat Arches, four or five Foot wide, and 14 or 16 Foot high, may be worth 40 or 50 Pounds.

A Pair of Rustick Peers of Stone, may be worth 12 or 15 Pounds, according to their Height and Substance.

Plain Peers, 8 or 10 Pounds; revail'd and Pilaster Peers, from 12 to 14 Pounds a Pair.

PELLICOIDES [in *Geometry*] a Figure in Form of a Hatchet.

PENDENTIVE [in *Architecture*] the whole Body of a Vault, suspended out of the perpendicular of the Walls and Bearing against the Arc-Boutants.

Daviler describes it as the Portion of a Vault between the Arches of a Dome, usually inrich'd with Sculpture; and *Felibien* takes it for the Plain of a a Vault, contain'd between the Double Arches, the forming Arches and the Ogives.

The *Pendentives* are usually of Brick or soft Stone, but Care is to be taken that the Couches or Beds of Masonry be always laid Level and in right Line, proceeding from the Sweep whence the Rise was taken, the Joints too must be made as small as possible, to save the Necessity of filling them up with Wood, or of using much Mortar.

PENDULUM [in *Mechanicks*] is any heavy Body so suspended, as that it may Vibrate or Swing backwards and forwards about some fixt Point, by the Force of Gravity.

PENTADORON, a kind of *Bricks* so call'd, See *Bricks*.

PENTAGON [in *Geometry*] a

a Figure with five Sides and five Angles.

PENTANGLE [in *Geometry*] a Figure having five Angles.

PENTASTYLE [in *Architecture*] a Building having five Rows of Columns.

Such was the Portico begun by the Emperor *Gallian*, and which was to have been continued from the *Flaminian* Gate to the Bridge *Milvius*, *i. e.* from the *Porto del Populo*, to the *Ponte-mole*.

PERIDROME [in the antient *Architecture*] the Space, Gallery, Alley or the like in a *Periptere* between the Columns and the Walls.

PERIPHERY [in *Geometry*] is the circumference or bounding Line of a Circle, Ellipsis, Parabola and similar Figures.

The Periphery of every Circle is suppos'd to be divided into three hundred and sixty Degrees, which are again subdivided each into sixty Minutes, the Minutes into Seconds, &c.

PERIPTERE [in the antient *Architecture*] a Building encompass'd on the Out-side with a Series of insulated Columns forming a kind of Isle all around.

Such were the *Basilick* of *Antonine*, the *Septizon* of *Severus*, the *Portico* of *Pompey*, &c.

The *Peripteres* were properly Temples, which had Columns on all the four Sides, by which they were distinguish'd from the *Prostyle* and *Amphyprostyle*, the one of which had no Columns before, and the other none on the Sides.

M. *Perrault* observes, that *Periptere*, in the general Sense, is the Name of a Genus including all the Species of Temples, which have Portico's of Columns all around; whether the Column be Diptere or Pseudo-Diptere, or simply *Periptere*, which is a Species that bears the Name of a Genus, and which has its Columns distant from the Wall, by the Breadth of an Intercolumniation.

PERITROCHIUM [in *Mechanicks*] as *Axis in Peritrochio* is one of the six Mechanical Powers, or simple Machines contrived for the raising of Weights,

PERFECT *Numbers*, are such whose aliquot or even Parts joined together will exactly return the whole Number as 6 and 28, &c. For of 6 the half is 3, the third Part 2, and the sixth Part one; which added together, make 6, and it hath no more aliquot Parts in the whole Numbers; so 28, which has these Parts 14, 7, 4, 2 and 1 exactly return 28, which therefore is a perfect Number, whereof there are but 10 between 1 and 1000000000.

PERPENDICULAR [in *Geometry*] is a Line falling directly on another Line, or so as to make equal Angles on each Side call'd also a *normal Line*.

From the very Notion of Perpendiculars, it follows,

1. That Perpendicularity is mutual, *i. e.* if a Line be perpendicular to another, that other is also Perdendicular to the First.

2. That only one Perpendicular can be drawn from one Point in the fame Place.

3. That if a Perpendicular be continued through the Line it was drawn Perpendicular to, the Continuation will be Perpendicular to the fame.

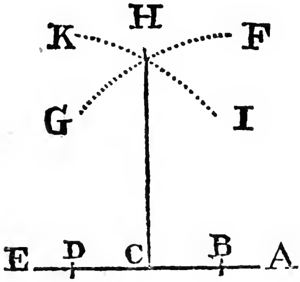
4. That if there be 2 Points of a Right Line, each of which is at an equal Diftance from 2 Points of another Right Line, that Line is Perpendicular to the other.

5. That a Line which is *Perpendicular* to another, is alfo Perpendicular to all the Parallels of the other.

6. That a Perpendicular Line is the fhorteft of all thofe which can be drawn from the fame Point to the fame Right Line.

Hence the Diftance of a Point from a Line, is a Right Line drawn from the Point *Perpendicular* to the Line or Plane; and hence the Altitude of a Figure is a *Perpendicular* let fall from the Vertex to the Bafe.

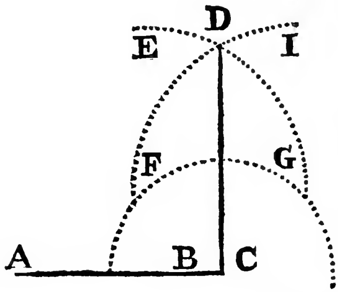
To erect the Perpendicular H, G, in or near the middle of the Right Line, A.



From the Point C fet off any equal Diftances to B and D, then with any opening Greater than B C, on the Points B and D defcribe the Arches F G, and I K interfecting each other in H.

2*d*, Draw the Right Line H C, and it is the Perpendicular required.

To erect the Perpendicular C D, from C the End of the the Right Line, A C.



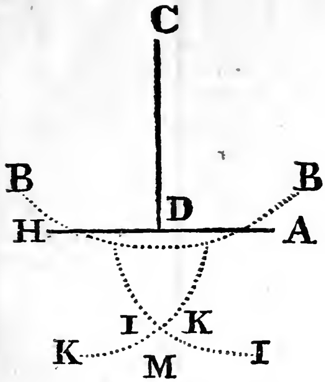
Firft, On C with any Opening of the Compaffes defcribe the Arch B F G H, and let the Opening as G B, from B to F, and from F to G; then iwth the fame, or a greater Opening of the Compaffes on the Points F and G defcribe Arches as F I, and G E, interfecting in D.

2*d*, Draw the Right Line D, C, and 'tis the Perpendicular requir'd.

To let Fall the *Perpendicular* from the given Point C on the Right Line A, H.

Firft, with an Opening of the Compaffes, greater than C, D, defcribe an Arch as B, B, interfecting the Right Line A, H, in the Points G and N.

2*d*,



2*d*, With the Distance G N on G and N, describe the Arches I I and K K, intersecting each other in M; then Draw the Right Line C M, and C D will be the Perpendicular let Fall, as requir'd.

PERPENDICULAR *to a Parabola*, is a Right Line cutting the Parabola, in the Point in which any other Right Line touches it, and is also it self *Perpendicular* to that Tangent.

A Line is said to be Perpendicular to a Plane, when it is *Perpendicular* to all the Lines it meets with in that Plain: and a Plane is *Perpendicular* to another Plane, when a Line in one Plane is *Perpendicular* to the other Plane.

PERRON [in *Architecture*] is a Stair-case lying open, or on the Outside of the Building: properly the Steps in the Front of a Building, or raised before the Doors of great Houses, which lead into the first Story, when raised a little above the Level of the Ground.

Perrons are made of different Forms and Sizes, according to the Space and Height they are to lead to.

Sometimes the Steps are Round and Oval; but more commonly Square.

PERRON, according to M. *Le Clerc*, is an Ascent or Elevation given to the Elevation of a Building.

The Portail or Frontispiece of a Church, Palace or any other great Building, should always have a Rise of some Steps, that is in a Word, it ought to have a *Perron*.

The Rest or Landing Place of a *Perron*, should always be extended in width as far as the Frontispiece, if possible; and the Steps, according to *Vitruvius*, must always be an odd Number.

These Steps should always be five or six Inches in Height, and ten or twelve Inches in Breadth; that is, their Breadth must be Double their Height; which is found the best Porportion, to have an easy and common Ascent.

Where a *Perron* is thirteen or fifteen Steps high; 'tis necessary, at least 'tis Convenient, to interrupt its Range with one or two Landing Places, that there mayn't be too many Steps to Mount successively, and that the Eye may not be displeased in Ascending so great a Height without Rests.

A *Perron* should always be confined to the Height of the *Zocle* or Foot of the whole Building.

But tho' this *Zocle* or Foot serve as a continued Pedestal, yet

yet it must neither have a Base nor Corniche, when its Height is taken up by a *Perron*; and M. *Le Clerc* says he cannot agree with *Palladio*, in the Examples he has given to the contrary.

PERSIAN ORDER } [in PERSIC ORDER } *Architecture*] is an Order of Columns which has the Figures of *Persian* Slaves to support the Entablement instead of Columns, as the *Caryatic* Order has the Figures of Women for the same Purpose.

This Order was first used by the *Athenians*, on Occasion of a Victory obtain'd over the *Persians* by their General *Pausanias*, as a *Trophy* of this Victory, The Figures of Men drest according to the *Persian* Mode, with their Hands bound before them, and other Characters of Slavery, were charg'd with the Weight of *Doric* Entablatures, and made to do the Office of *Doric* Columns.

M. *Le Clerc*, says, that *Persian* Columns are not always made with the Marks of Slavery, but are frequently used as Symbols of Virtues and Vices, of Joy, Strength, Valour, &c. and even of Fabulous Deities made in the Figure of *Hercules*, to signify Strength; of *Mars*, to represent Valour; of *Mercury*, to represent Dexterity; and of Fauns or Saytrs, &c. to inspire Mirth and Jollity.

PERSPECTIVE, is an Art which teaches us the Manner of Delineating by Mathematical Rules; it shews us how to Draw Geometrically upon a Plane, the Representations of Objects according to their Dimentions, and different Situations, in such Manner, that the said Representations produce the same Effects upon our Eyes, as the Objects, whereof they are Pictures. Or

It is the Art of delineating visible Objects on a Plane Surface, such as they appear at a given Distance or Height, upon a transparent Plane, placed Perpendicular to the Horizon, between the Eye and the Object.

This is called particularly *linear Perspective*, as respecting the Position, Magnitude, Form, &c. of the several Lines or Contours of Objects, and expressing their diminution: this is opposed to *aerial Perspective*.

Aerial Perspective has Regard to the Colour, Lustre, Strength, Boldness, &c. of distant Objects, considered as seen through a Column of Air, and expresses the delineation thereof.

Perspective is imploy'd either in representing the Ichnographies, or Ground Plats of Objects, as projected on Perspective Planes, or in *Scenographies*, or Representations of the Bodies themselves.

The General Laws of each are subjoined; in Order to which it is necessary to premise the following *Lemmas* in *Perspective*.

1. That the Appearance of a Right Line, is ever a Right Line; whence the two Extremes being given, the whole Line is given.

2. That if a Line be Perpendicular

Plate XVIII.

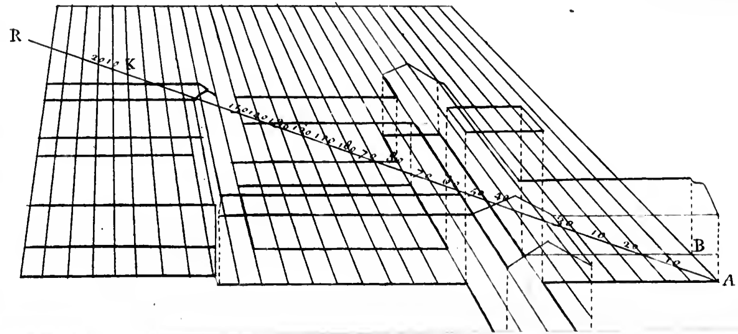
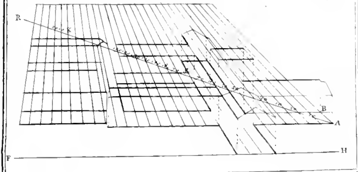


Plate XVIII.



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cular to any Right Line drawn a Plane, it will be Perpencular to every other Right ine drawn on the same Plane.

3. That the Height of a oint appearing on the Plane, to the Height of the Eye, as e Distance of the objective oint from the Plane, to the ggregate of that Distance, nd the Distance of the Eye.

PERSPECTIVE of BUILDING, &c.

In the Practice of the *Perspective* of Building, &c. Great Regard must be had to the Height of the horizontal Line, ll above the horizontal being een in the upper Part, and all ibove it, in the under Part; whence Perspective becomes divided into the high and low Sight, both which will be sufficiently illustrated by what follows.

To represent a Building (*v. gr.* Palace, College, &c.) *in Perspective*. See the *Plate*.

1. Take the Ichnography or Ground Plot of the Building; its Length, Breadth, and Depths, by actual measuring, and take its Altitude with a Quadrant.

2. Make a Scale divided into 2 or 300 equal Parts, either actually, or 10, as that each Division signifies ten Parts; by this Scale, lay down the Ground Plot.

When you have done this, having a long Ruler and a Square, which by sliding on a Rule, helps to draw your Perpendicular easier, reduce it into *Perspective*, in its Scenographick Appearance.

Then having drawn a Line towards the Bottom of the Paper, for the Front or Base Lines, as F L, divide it into as many equal Parts, as you find the Building have in the Ichnography, or more if you please. This will serve as a Scale to determine the several Heights, &c. and to these Divisions with a black Lead Pencil, draw Lines from the Centre when you have chosen it; which Choice requires Judgment upon two Accounts.

For if the Centre be too nigh the Front Line, then the Depth of the whole Building will foreshorten too much; and if too far off, it will not fore-shorten enough.

This may be illustrated thus, Set a Drinking Pot, or the like Vessel on a Stand, so that it be a little lower than your Eye, if you be at a great Distance from it, you can see very little or nothing into it; but if you come nigher to it by Degrees, you will perceive the farther Edge seem to be rais'd a little higher than that next to you, so that you may see a little Way into it; if you come very nigh it, you see deeper into it, and more than can well be express'd in Picture.

You must therefore find some one Place which you conclude the most convenient for the Draught, and which may be in general determin'd to be as far off the Front Line, as the Front Line is long.

This Rule, tho' it has just Grounds, yet we sometimes dispense

dispense with it, *pro re nata*; that we may express Things with the better Appearance.

Consider how to place this Centre with such Advantage, that you may express those Things most, that you chiefly design to do; for as to the Bottom and Top Lines of the Sides of the Building that run from you in or nigh the direct Line to the Centre, tho' the upper Part is seen very well, yet the Sides that fall between the Ground Line and the Top, fall so very near one to the other, that it would be very difficult to express Particulars in them; so that the the Centre ought to be well chosen in regard to this.

Therefore those Buildings you would see most of, must be plac'd as far off as you see convenient from the direct Line that runs from the Centre, and the farther they are, the plainer they are. Then place those Things which you would have least seen, nighest to the direct Line; and observe whether the others fall according to your Mind; but this is to be done after you have drawn your Diagonal, which is the next Thing.

Having pitch'd on your Centre, and having drawn Lines from it to every Division of the Front Line, you must next determine your Diagonal A R, thus: Having measured the Front Line with a Pair of Compasses, set one Foot of the Compasses in the Centre, and take Notice where the other will reach in the Horizon (on both Sides if you please) and where it rests from that Point, draw a thwart Line from it to the last Division of the Front; and this will be truly drawn, or pretty nigh to the Truth.

That this is so, you may obseve how it falls in Respect of the two last Centre Lines; for if you draw a parallel, where the next Line from the last is intersected by the Diagonal, to the Front between them, as at A 10, you will have a *Rhombus*, if then all the Sides be pretty equal, you may be sure you are pretty nigh the right; but if the Sides which run towards the Centre, be too long, then Things will not fore-shorten enough; if the Sides be not long enough, then they will fore-shorten too much.

After you have thus divided the Front Line, fix'd the Centre, and plac'd the Diagonal, take the Breadth of the Chappel A B, which in the Ichnography is shewn to be 20 Parts; because this Line is perpendicular, it must run toward the Centre, therefore reckon 20 in the Diagonal, and the Rule being laid parallel to the Front in that Point, will give you a Point in the Centre Line, which will give the Breadth of the Chappel; and of Consequence, a Line drawn from A to B, puts it into the Ichnographick *Perspective*.

The Length of the Chappel being 70 Divisions in the Front Line, reckon 70 from B, parallel to the Front Line, and there you will have a Point at C.

The

The Depth of the Building from the Chappel, Northward, being 115 from the Chappel, you are to reckon from D, where it cuts the Diagonal at D) onwards in the Diagonal, with the Ruler as before, parallel in this Place in the Front, and there is found the Point Z, in the Central Line. The Breadth of it being 30, you reckon three Divisions, and the just Breadth is there, and so on every particular Part.

The Ichnography being thus plac'd into *Perspective*, you may then give every Thing its proper Height, thus

The Height of the Chappel being 30, you are to reckon 30 on the Front Line, and to drop a perpendicular to that Height by a Square clapt to the Front Line; and so where the other Side of the Chappel is plac'd, having reckon'd the Height upon the suppos'd Parallel, and there draw another Line in thatHeight; then joining these several Heights by several Lines, you will have the Profiles of each Building.

Now to diversify these several Lines, that they may not confound you, make the Ichnography, when you lay it into *Perspective*, in discontinued crooked Lines, the Heights, in prick'd Lines, and the Tops of each Building, in continued Lines, as the Centre Lines are in the Table.

You will also find the Centre, altho' it is not here express'd, as likewise the Point of Distance, by continuing the Diagonal up to the suppos'd Horizon, where it and the Eye is plac'd.

When these Things are done, you must employ your Art for the particular Expression of Things, by Drawing and Shadowing, which is the Life of this half form'd Figure, which is to be left to the Painter.

The *Low Sight* remains to be spoken of: Here the Horizontal is suppos'd just the Height of the Eye, about five Foot from the Basis; tho' 'tis generally plac'd higher, even to a third Part of the Height of the Building, that the Side Buildings may be express'd more gracefully.

The Diagonal is best determined by dividing the last Division of the Basis Line, into five Parts at G, taking four of these, sometimes the whole five, because it was before determin'd, that the Length of the Front Line, was the Distance of the Eye in the Horizon, to the Point of Distance: but here you are to take four, and then make this the Distance in the Horizon, between the Eye and the Point of Distance.

Then you may either graduate the Plan at the several Intersections of the Diagonal with the Centre Lines, or else suppose it so; and then raise the Building, as you will find by *Perspectives* enough of this Sort every where to be met with.

PERSPECTIVE is also us'd for a kind of Picture or Painting, frequently seen in Gardens, and at the End of Galleries; design'd expresly to deceive

deceive the Sight, by representing the Continuation of an Alley, a Landskip, a Building, or the like.

PERSPECTIVE *Plane*, is a Glass or other transparent Surface, suppos'd to be plac'd between the Eye and the Object, perpendicular to the Horizon, unless the contrary be expressly mention'd.

PHAROS } a Light House,
PHARE } a Pile rais'd near a Port, in which a Fire is kept burning in the Night, to guide and direct Vessels near at Hand.

PIAZZA [in *Architecture*] popularly call'd *Piache*, an *Italian* Name for a Portico.

It signifies a broad open Place or Square; whence it became apply'd to Walks or Portico's around them.

PIEDOUCH [in *Architecture*] is a little Stand or Pedestal, either long or square, inrich'd with Moulding; serving to support a Bust, or other small Figure.

PIEDROIT [in *Architecture*] is a Peer or a Kind of square Pillar, part of which is hid within a Wall; the only Thing wherein it differs from a Pilaster is, that the Pilaster has a regular Base and Capital, which the Piedroit wants.

PIEDROIT is also us'd to signify a Peer or Jaumb of a Door or Window; comprehending the *Chambranle*, *Chamfering*, *Leaf*, &c.

PILASTER [in *Architecture*] a square Column, sometimes insulated; but more frequently let within a Wall, and only shewing a fourth or fifth Part of its Thickness.

The Pilaster is different ; different Orders, it borrow the Name of each Order, an has the same Proportions, an the same Capitals, Member and Ornaments with the Co lumns themselves.

Pilasters are usually with out swelling or Diminution, a broad at Top as at the Bottom tho' some of the modern Ar chitects, as M. *Mansard* &c diminish them at Top, and even make them swell in the middle, like Columns, especially when plac'd behind Co lumns.

M. *Perrault* observes that *Pilasters* like Columns, become of different Kinds, according to the different Manner wherein they are apply'd to the Wall.

Some are wholly detach'd, these *Vitruvius* calls *Parastata*; others have three Faces clear out of the Wall; others two; and others only one; all these *Vitruvius* calls *Antæ*.

Insulate Pilasters are but rarely found in the Antique; the chief Use the Ancients made of Pilasters, was at the Extremities of Portico's, to give the greater Strength.

There are four Things to be principally regarded in *Pilasters*, *viz.* 1. Their Projecture out of the Wall. 2. Their Diminution. 3. The Disposition of the Entablature, when it happens to be common to them, and to a Column, and 4 their Flutings.

1. The *Projecture* of Pilasters,

ters, which have only one Face out of the Wall, ought to be $\frac{1}{3}$ of their Breadth; or at moſt not above $\frac{1}{6}$.

The Projecture may be a quarter of their Diameter when they receive Impoſts againſt their Sides.

2. *Pilaſters* are ſeldom diminiſh'd when they have only one Face out of the Wall.

Indeed the *Pilaſters* are to have the ſame Dimenſions with the Columns, where they ſtand in the ſame Line with Columns and the Entablature is continued over both without Break; that is to ſay, on the Face reſpecting the Column; the Sides being left without Diminution.

3. *Pilaſters* are ſometimes fluted, tho' the Columns that they accompany are not; and on the contrary, the Columns are ſometimes fluted, when the Pilaſters that accompany them, are not.

The Flutings of *Pilaſters* are always odd in Number, except in half Pilaſters, which meet at inward Angles, where four Flutings are made for three, *&c.*

4. The Proportions of the Capitals of *Pilaſters* are the ſame as to Height with thoſe of Columns; but differ in Breadth, the Leaves of *Pilaſters* being much broader, becauſe that *Pilaſters* having equal Extent, have only the ſame Number of Leaves for their Girt, *&c. viz.* eight.

Their ordinary Diſpoſition is to have two in each Face in the lower Row, and one in the middle in the upper Row, and two halves in the Angles, in the Turns of which they meet.

To this may be added; that the Run of the Vaſe or Tambour, is not ſtrait, as the lower Part is; but a little circular and prominent in the middle.

In Pilaſters which ſupport Arches, *Palladio* ſhews, that the Proportions muſt be regulated by the Light they let in; and at Angles, by the Weight they ſuſtain.

Sir *Henry Wootton* tells us, as to their Sight and Situation, that *Pilaſters* muſt not be too tall and ſlender, leaſt they reſemble Pillars; nor too dwarfiſh and groſs, leaſt they imitate Piles or *Peers* of Bridges.

That Smoothneſs does not ſo naturally become them as a Ruſtick Superficies; for they aim more at State and Strength than Elegancy.

That in private Buildings, they ought not to be narrower than $\frac{1}{3}$, nor broader than $\frac{2}{3}$ of the Vacuity, or inter Space, between Pilaſter and Pilaſter; but as for thoſe that ſtand at the Corners, they may have a little more Latitude allow'd them, by Diſcretion for the Strength of the Angles.

Palladio obſerves, that in Theatres and Amphitheatres, and ſuch maſſive Works, they have been as broad as the half, and ſometimes as the whole Vacuity or Interſpace.

He alſo takes Notice (and others agree with him) that their true Proportion ſhould be an exact Square, but (for leſſening of Expence, and enlarging

of

of Room) they are usually made narrower in Flank than in Front.

Their principal Grace consists in half or whole Pillars, apply'd to them, in which Cases, Authors have well observ'd that the Columns may be allow'd Something above their ordinary Length, because they lean to so good Supporters.

As to the Price of *Pilasters*, They are sometimes measured and rated by the Foot running Measure, and valued at so much *per* Piece, according to the Size, Goodness of the Materials, and Curiosity of the Workmanship.

PILASTER *Bricks*, See *Bricks*.

PILASTERS are square Columns, as big at Top as Bottom.

These Pilasters are often us'd for mere Show; as when they appear inserted or let within the Wall, not discovering above a fifth or sixth Part of their Bigness.

These kinds of Pilasters, which may be call'd flat Pilasters, are always found to have a better Effect than others, which being intire, ordinarily appear heavy and lumpish.

When these Pilasters accompany Columns, they should have the same Heights with the Columns in every Part; but if they be alone, *i. e.* if they be not accompanied with any Columns, their Measures and Proportions should be varied.

First, In the *Roman*, *Spanish* and *Corinthian* Orders, the Capitals of Pilasters to be well proportioned should be higher than those of Columns, as being broader; whence it follows, that their Shafts ought also to be augmented in Proportion.

Secondly, It may be observ'd in general, that a Pilaster made according to the Measures or Proportions of a Column, that is, containing an equal Number of Modules in Height, appears much shorter with Regard to its Breadth than the Column; and the Reason is that the Sides of the Pilaster being flat, appear in their full Breadth; which is otherwise in the Column, the Shadow of whose Roundness makes it appear slenderer than it really is. So that to make a Pilaster appear with the Beauty of a Column, the Height of its Shaft must be augmented, as well as that of its Capital; and consequently the Height of its Entablature, and that of its Pedestal, must be augmented likewise.

Further, the Capital of a Pilaster being broader than that of a Column, and the Profile of the Entablature beyond the naked of the Pilaster, continuing nearly the same, the Modillions are found farther apart from each other, than in the Orders of the Columns, whence it likewise follows that the Distances given for the Intervals of Columns adjusted by a certain Number of Modillions won't serve for the Intervals of Pilasters, no more than they will for determining the Proportion of Portico's.

A

And lastly, the Modillions being farther a-part from each other, the Cornice ought to have a greater Projecture, in Order to have perfect Squares between the Modillions, whereon the Regularity of the Soffit depends.

'Tis necessary therefore, to have particular Compositions for the Orders of Pilasters, distinct from those Columns; for this Reason says M. *Le Clerc* supposes the following ones, which answer to those of his Order of Columns.

Of the Projecture of PILASTERS. He says, the ordinary Projecture of these Pilasters beyond the Wall, is 10 or 12 Minutes, but when they terminate the Saliant Angle of a Building, their Thickness, should, if practicable, be regulated by the Parts of the Soffit or Plafond of the Cornice.

When Flutings are us'd in Pilasters, their Number should be seven on each Side; the first and last of which, may be a little further from the Angle, then the Rest are from each other; that the Extremities of the Pilasters, mayn't be too much weakened.

In some old Monuments we find Pilasters which have only five Flutings on a Side; but then those are too large, and make the Pilasters appear little and pitiful, and if there were nine, this would be too fine and slender, even for the most delicate Orders.

He Remarks, that we never make Flutings in the *Tuscan* Pilaster, and if by Chance we make any in the *Doric* (which however is very rare) we leave pretty large Spaces next to the two Extremities in Order to fortify the Angles.

One may either add a single Fluting in the Projecture or Thickness of the Pilaster, or leave it quite plain, provided it don't exceed ten Minutes.

Pilasters split or cloven from Top to Bottom, M. *Le Clerc* says in an inner Angle, never have a good Effect; for besides that their halves have no Symmetry with the entire Pilasters that answer to them, their Capitals do likewise become very defective, as is particularly seen in the Church of the *Val de Grace*.

When Columns and Pilasters are plac'd under the same Entablature, the Entablature must be that of the Columns.

When Columns and Pilasters are plac'd under the same Entablature, they should never if possible stand in the Front Line, by Reason of the manifest Irregularities that would follow thereupon; they must therefore be separated by a Ressaut or Difference in the Range.

A Ressaut can never consist of less than an entire Modillion, without ruining the Regularity of the Parts of the Soffit or Cornice.

Further, if the *Ressaut* don't exceed a Modillion, the Column will remain engag'd in the Body of the Building.

When Pilasters accompany insulate Columns and serve them as a Ground or *arriere Corps*,

Corps, they ought to be at a competent Diſtance from each other, to prevent their Capitals from interfering.

When a Pilaſter is plac'd behind a Column, the Breadth of the upper Part of its Capital ſhould be reduc'd to that of the upper Part of the Capital of the Column, to the End that their Baſes being of the ſame Breadth, their *Abacus* and Volutes may be ſo too.

PILE [in *Antiquity*] was a Pyramid built of Wood, on which the Bodies of Perſons deceaſed were laid in Order to be burnt.

PILE is alſo us'd to ſignify a Maſs or Body of Building.

PILES [in *Architecture*] are great Stakes rammed into the Earth to make a Foundation to build upon in marſhy Ground.

Amſterdam and ſome other Cities, are wholly built upon Piles. The Stoppage of *Dagenham* Breach is effected by Dove-Tail *Piles* mortois'd into one another, by a Dove-Tail Joint.

PILLAGE [in *Architecture*] is ſometimes us'd by ſome Builders, for a ſquare Pillar ſtanding behind a Column to bear up the Arches; having a Baſe and Capital as a Pillar has.

PILLAR [in *Architecture*] is a kind of irregular Column, round and inſulated, deviating from the Proportions of a juſt Column.

Pillars are always either too maſſive or too ſlender for a regular Architecture; ſuch are the Pillars which ſupport *Gothic* Vaults or Buildings.

In Effect, *Pillars* are not reſtrain'd to any Rules; their Parts and Proportions being arbitrary.

PILLARS or PIEDROITS of the *Roman* Order. In Portico's where the Columns have Pedeſtals, the *Pillars* or *Piedroits* ought to be four Modules in Breadth; but if they be more, M. *Le Clerc* ſays, they will be ill proportion'd to their Columns; an Inſtance of which we have in the great *Compoſite* Portico of *Palladio*; to which it may be added that the Inter-Columns in that Caſe, would likewiſe be too big; as may be obſerv'd in the *Doric* Order of *Vignola*, where the Pillars of his great Portico, being of five Modules, the Columns are found too far diſtant from one another.

He alſo remarks, that *Palladio* in the *Roman* Order terminates theſe Pillars with the Mouldings of the Baſe of the Pedeſtal, which he continues quite round, ſo that the Baſe of the Pedeſtal, becomes confounded with that of the Piedroit; a Thing, that in his Opinion ought to be avoided.

For if thoſe Mouldings be proportion'd to the Height of the Pedeſtal, they can't be ſo to that of the Pillar: Beſides, that by advancing a good Way within the Paſſage, they become incommodious, and are ſoon broken and defeated.

Vignola terminates theſe Pillars with a plain Zocle, which here ſuits very well.

When the Columns have no Pedeſtals, he terminates the

Pillars with a Zocle, equal to the Base of the Column.

A *Butting* PILLAR is a Buttress or Body of Masonry, rais'd with a Design to prop or sustain the shooting of a Vault, Arch or other Work.

A *Square* PILLAR, is a massive Work of Masonry, call'd also a *Peer* or *Piedroit*, serving to support Arches, *&c.*

PINION [in *Mechanicks*] is an Arbor or Spindle, in the Body whereof are several Indentures or Notches, which catch the Teeth of a Wheel, that serves to turn it round, or a *Pinion* is a lesser Wheel, which plays in the Teeth of a larger.

PINNACLE [in *Architecture*] is the Top or Roof of a House, which terminates in a Point.

This Sort of Roof among the Ancients was appropriated to Temples; they making their ordinary Roofs flat, or in the Platform Way.

The *Pediment* is said to have taken its Rise from the Pinnacle.

PINNING [with *Bricklayers*] is the fastening of Tiles together with Heart of Oak, for the Covering of a House, *&c.* Pinning is said by some *Sussex* Workmen, to be done for 8 *d.* per 1000, for finding Pins and Pinning of Tiles; but for the Workmanship only 6 *d.*

PINS *for Tileing.* It is customary to allow two Gallons of Tile Pins to every Thousand of Tiles. These Pins Mr. *Leybourn* says, are in Price from 3 *d.* to 6 *d.* the Gallon.

Others say that they use a Gallon of Pins to a square and half of Tileing.

PIPES [in *Building*, *&c.*] Canals or Conduits for the Conveyance of Water, *&c.*

Pipes for Water, Water Engines, *&c.* are usually of *Lead*, *Iron*, *Earth*, or *Wood*; those of Timber, are ordinarily either Oak or Alder.

Iron Pipes are cast in Forges; their Length is about two Foot ½, several of which are pieced together by Means of four Screws at each End, with Leather or old Hat between them to stop the Water.

Earthen Pipes are made by Potters. These are fitted into one another, one End being always made wider than the other. To join them the closer and prevent their leaking, they are covered with Tow and Pitch, Their Length is commonly about two Foot ½.

The wooden Pipes are Trees bored with large Iron Augurs of different Sizes, beginning with a less, and then proceeding with a larger successively; the first being pointed, the Rest form'd like Spoons, increasing in Diameter from one to six Inches: they are fitted into the Extremities of each other; and are sold by the Foot.

Leaden Pipes are of two Sorts, the one soldered, the other not soldered, for the Construction of each Sort, See *Lead* and *Plumbery.*

PISTON is a Part or Member of several Machines, as Pumps, *&c.*

The *Piston of a Pump*, is a ſhort Cylinder of Metal fitted exactly to the Cavity of the Barrel or Body; and which being work'd up and down alternately in it, raiſes the Water, and when rais'd, preſſes it again, ſo as to cauſe it to force up a Valve, with which it is furniſh'd, and ſo eſcape thro' the Noſe of the Pump.

PITCH.

PITCH [in *Architecture*] is the Angle, a Gable End, and conſequently the whole Roof of a Building.

If the Length of each Rafter be $\frac{3}{4}$ of a Building, the Roof is ſaid to be *True Pitch*.

If the Rafters are longer, 'tis ſaid to be a *high* or *ſharp pitch'd* Roof; if ſhorter, which ſeldom happens, it is ſaid to be a *low* or *flat pitch'd* Roof.

PITCHING, the ſame as *Paving*, which ſee.

PIVOT [in *Building*] is a Foot or Shoe of Iron or other Metal, ordinarily conical or terminating in a Point; by Means of which a Body which is intended to turn round, bears on another, fix'd at Reſt, and perform its Turns or Circumvolutions.

Large Gates, &c. uſually turn on Pivots. The Ancients relate that they had Theatres in *Rome*, which would contain 80000 People, which yet turned on a ſingle Pivot.

PLACARD [in *Architecture*] is the Decoration of the Door of an Apartment, conſiſting of a *Chambranle*, crown'd with its *Frieze* or *Gorge*; and its Corniche ſometimes ſupported by Conſoles.

PLACE [in *Opticks*] or *Optick* PLACE, is the Point to which the Eye refers an Object.

PLACE *Bricks*, See *Bricks*.

PLAFOND } [in *Ar-*
PLATFOUND } *chitecture*] is the Ceiling of a Room whether it be flat or arch'd; lin'd with Plaiſter or Joiner's Work, and frequently enrich'd with Painting.

PLAFOND is alſo more particularly us'd for the Bottom of the Projecture of the *Larmier*, of the Cornice, call'd alſo the *Soffit*.

PLAIN *Cornice*. See *Cornice*.

PLAIN FIGURE [in *Geometry*] is a Plane Surface, from every Point of whoſe Perimeter, Right Lines may be drawn to every other Point in the ſame.

PLAIN *Angle* [in *Geometry*] is an Angle contain'd under two Lines or Surfaces, ſo call'd in Contra-diſtinction to a ſolid Angle.

PLAIN *Triangle* [in *Trigonometry*] is a Triangle included under three Right Lines or Surfaces, in Oppoſition to a ſpherical or mixt Angle.

PLAIN *Trigonometry*, is the Doctrine of Plain Triangles, their Meaſures and Proportion.

PLAIN GLASS *Mirror*, &c. [in *Opticks*] is a Glaſs or Mirror, whoſe Surface is flat or even.

PLAIN *Tile*. See *Tile*.

PLAIN SCALE, is a thin Ruler, either of Wood or Braſs, whereon are gratuated the Lines of Chords, Sines and Tangents, Leagues, Rhumbs &c. and is of ready Uſe in moſt

most Parts of the Mathematicks.

PLAIN *Table*, is an Instrument u'sd in surveying of Land.

1. The Table it self, is a Parallelogram of Wood, 14 Inches and a half long, and about 11 Inches broad.

2. A Frame of Wood fix'd to it, so that a Sheet of Paper being laid on the Table, and the Frame being forc'd down upon it, squeezeth in all the Edges, and makes it lie firm and even, so that a Plot may be conveniently drawn upon it.

Upon one Side of this Frame should be equal Divisions for drawing Parallel Lines, both long Ways and cross Ways (as Occasion may require) over the Paper; and on the other Side, the 360 Degrees of a Circle, projected from a Brass Centre, conveniently plac'd on the Table.

3. A Box with a Needle and Card, to be fix'd with two Screws to the Table, very useful for placing the Instrument in the same Position upon every remove.

4. A three legg'd Staff to support it; the Head being made so as to fill the Socket of the Table, yet so as the Table may be easily turn'd round upon it, when 'tis fix'd by the Screw.

5. An Index, which is a large Ruler of Wood (or Brass) at the least 16 Inches long, and two Inches broad, and so thick as to make it strong and firm; having a sloped Edge (call'd the fiducial Edge) and 2 Sights of one Height (the one of which has a Slit above and a Thread below) to be set in the Rulers, so as to be perfectly of the same Distance from the fiducial Edge.

Upon this Index it is usual to have many Scales of equal Parts, as also Diagonals and Lines of Chords.

By this Instrument the Draught or Plan is taken upon the Spot, without any future Protraction or Plotting.

PLASTERING, some Workmen in *Sussex* say, that they have for Lathing and Plastering with Lome on both Sides, 3 *d.* *per* Yard; but with white Lime and Hair Mortar on both Sides, 4 *d. per* Yard.

Some tell us that at *Tunbridge Wells* they will do the Plaistering of Walls (where they plaster over all the Timber) and Cielings, for 2 *s.* 10 *d.* *per* Square; and some say, they have had it done for 2 *s.* 6 *d.*

Of Plaistering Ceilings.] They have in *Sussex* for Plastering of Ceilings, Lathing and finishing, 4 *d. per* Yard.

And in some Countries, where they make their Plaster of Reed, Lime and Hair, they perform the Workmanship singly for 3 *d.* *per* Yard; but if the Workmen find all Materials, 'tis worth 5 *d.* or 6 *d.*

Plastering with rough Mortar, call'd *Rough Casting.*] In *Kent* they Rough cast upon old Loam-Walls, that is they give them one Coat upon the Loam of *Rough Cast* or *Rough Mortar*, tho' it be commonly

ſtruck ſmooth like Lime and Hair, for $3\frac{1}{2}$ *d. per* Yard, Workmanſhip only.

But if the Wall be new, and Lathed and Plaſtered with Loam on both Sides, they have 4 *d. per* Yard for Workmanſhip.

But if the Rough Caſting be wrought in Flouriſhes, they have 8 *d. per* Yard for Workmanſhip ſingly; but if the Workman find all Materials, 'tis worth from 1 *s.* to 3 *s. per* Yard, according to the Goodneſs and Variety of the Work.

Of Plaſtering on Laths, in Imitation of Brick.] For this Sort of Work, the Plaſter is made of Powder of Bricks, ſharp Sand, Lime and ſome Red Oker.

Some of this Plaſtering will look like a Brick Houſe, ſo as to deceive Paſſengers paſſing by, and look well for 20, 30, or 40 Years. This Work is valued at 1 *s. per* Yard for Workmanſhip only.

Of Plaſtered Floors.] Mr. *Wing* ſays this Work is worth, (the Workman finding all Materials) 1 *s.* 4 *d. per* Yard; but the Workmanſhip only from 4 *d.* to 6 *d.*

Plaſter may be had at the Pits for 4 *s.* or 4 *s.* 6 *d. per* Load, or 40 Hundred Weight, which will lay about 40 Yards of Flooring.

Of White Waſhing.] With Size upon plaſtered Walls, is uſually reckon'd at 2 *d. per* Yard.

Of Meaſuring.] This is uſually computed by the Yard ſquare, as *Paving* is. See *Paving*. But you are to take Notice, that in meaſuring Partitions, if the Workman finds Materials, the Doors and Windows being meaſured by themſelves, are deducted out of the whole; as is alſo $\frac{1}{6}$ Part of the Reſt, for the Quarters in rendering Work.

But if the Workman does not find Materials, he does not commonly make any Allowance for them, the Trouble of cutting and fitting the Laths being accounted equivalent to the void Spaces, left for the Doors and Windows.

Nor is there to be made any Allowance in Caſe of Workmanſhip only (in rendering) for the Quarters, Braces, or Interties, the Work being as much (if not more) than if it were all Plain. See *Pargeting*.

The Meaſuring of PLASTERERS *Work.*

PLASTERERS Works are chiefly of two Kinds.

1*ſt*. Lath'd and Plaſtered Work, which they call *Ceiling*.

2*dly*. Render'd Work which is of two Sorts, *viz.* upon Brick Walls or between Quarters, in the Partitions between Rooms; all which are meaſured by the Yard Square, or Square of 3 Feet, which is 9 Feet.

1*ſt*. Of *Ceiling*. If a Ceiling be 59 Feet, 9 Inches long, and 24 Feet 6 Inches broad, how many Yards are contain'd in that Ceiling?

Multi-

Multiply 59 Feet, by 24 Feet, 6 Inches, and the Product will be 1463 Feet, 10 Inches, 6 Parts, which divided by 9, the Quotient will be 172 Yards, 5 Feet.

F.	I.	
59	9	
24	6	
236		
118		
209	10	6
18	00	0
1463	10	6

59.75
2415

29875
23900
11950

9) 1463.875
Answer 162 : 5

By Scale and Compasses.

Extend the Compasses from 9 to 59 Feet, 9 Inches, and that Extent will reach from 24 Feet, 6 Inches, to 162.5. Yards.

2dly. Of Rendering.

Example. If the Partitions between Rooms be 141 Feet, 6 Inches about, and 11 Feet 3 Inches high, how many Yards do those Partitions contain?

Multiply 141 Feet 6 Inches, by 11 Feet 3 Inches, and the Product will be 1591 Feet, 10 Inches, 6 Parts; which being divided by 9, will give 176 Yards, 7 Feet, the Answer.

	F.	I.	
	141	6	
	11	3	
	1556	6	
	35	4	6
9)	1591	10	6
Answer	176	7	0

141.5
11.25

7075
2830
1415
1415

9) 1591.875

176.87

Answer 176.87 Yards.

By Scale and Compasses

Extend the Compasses from 9 to 141.5, and that Extent will reach from 11.25. to 176. 87 Yards.

Note 1. If there are any Doors, Windows or the like in the Partitioning, Deductions must be made for them.

Note 2. That when *Rendering* upon Brick-Walls is measured, no Deductions are to be made; but when *Rendering* is measured between Quarters, one fifth Part may be very well deducted for the Quarters, Braces and Interties.

Note 3. Whiting and Colouring are both measured by the Yard, as *Ceiling* and *Rendering* were; and likewise in *Whiting* and *Colouring*, one fourth or at least one fifth Part is to be added; as one fifth Part is deducted in Rendering between Quarters.

PLAN, PLAIN, PLANE [in *Geometry*] is a *plain Figure* or Surface, lying evenly betwixt its bounding Lines. It is by *Wolfius* defin'd to be a Surface, from every Point of whose Perimeter, a Right Line may be drawn to every other Point in the same.

As the Right Line is the shortest Extent from one Point to another; so is a *Plane* the shortest Extension between one Line ond another.

Geometrical PLANE [in *Perspective*] is a Plane Surface, parallel to the Horizon, plac'd lower than the Eye, in which the visible Objects are imagined without any Alteration, except that they are sometimes reduc'd from a greater to a lesser Size.

Horizontal PLANE [in *Perspective*] is a Plane which is parallel to the Horizon, and which passes thro' the Eye, or hath the Eye suppos'd to be plac'd in it.

PLANE *of the Horopter* [in *Opticks*] is that which passes through the Horopter, and is perpendicular to the Plane of the optical Axes.

PLANE *Numbers*, is that which may be produc'd by the Multiplication of two Numbers the one into the other; thus 6 is a Plane Number, because it may be produc'd by the Multiplication of 3 by 2; so likewise 15 is a Plane Number, because it is produc'd by multiplying 5 by 3, and 9 is a Plane Number, produc'd by the Multiplication of 3 by 3.

PLANE PROBLEM [in the *Mathematicks*] is such a one as cannot be solv'd Geometrically; but by the Intersection either of a Right Line and a Circle; or of the Circumference of two Circles; as having the greater Side given, and the Sum of the other two, of a Right angled Triangle, to find the Triangle.

To describe a Trapezium, which shall make a given Area of four given Lines, and such a Right Line can cut a Circle, or one Circle another; but in two Points.

PLANE *of Reflection* [in *Catoptricks*.] is that which passeth through the Point of Reflection, and is always Perpendicular to the Plane of the Glass or reflecting Body.

PLANE *of Refraction*, is a Surface drawn through the incident and refracted Ray.

PLANE *Surface*, is that which lie even between its bounding Lines; and as a Right Line is the shortest Extension

tenſion from one Point to another, ſo a plain Surface is the ſhorteſt Extenſion from one Line to another.

Vertical PLANE, [in *Opticks* &c.] is a Plane Surface which paſſes along the principal Ray, and conſequently through the Eye, and is Perpendicular to the Geometrical Plane.

Horizontal PLANE [in *Mechanicks*] is a Plane level or parallel to the Horizon.

Inclin'd PLANE [in *Mechanicks*] is a Plane which makes an Obique Angle, with an Horizantal Plain.

PLANE [in *Joinery*, &c.] is an Edg'd Tool or Inſtrument for paring and ſhaving Wood ſmooth, even, &c.

It conſiſts of a Piece of Wood very ſmooth at Bottom, as a Stock or Shaft; in the middle of which is an Aperture, thro' which a Steel Edge or Chiſſel placed Obliquely paſſes, which being very Sharp, takes off the inequalities of the Wood, it is ſlid along.

Planes have various Names according to their various Forms, Sizes and Uſes.

1. The *Fore*-PLANE which is a very long one, and is uſually that which is firſt uſed, the Edge of its Iron, or Chiſſel is not ground Streight; but Riſes with a Convex Arch in the middle, to bear being ſet the ranker: the uſe of it being to take off the greater irregularities of the Stuff, and to prepare it for the ſmoothing Plane.

2. The *ſmoothing* PLANE is ſhort and ſmall, its Chiſſel or Iron being finer; its uſe is to take off the greater irregularities left by the *Fore-plane*, and to prepare the Wood for the Jointer.

3. The *Jointer* is the longeſt of all; its Edge being very fine, and not ſtanding above a Hair's Breadth: It is uſed after the Smoothing Plane, and is chiefly deſigned for ſhooting the Edge of a Board perfectly ſtrait, for jointing ſmooth Tables, &c.

4. *The Strike Block* is like the Jointer, but ſhorter: Its Uſe is to ſhoot ſhort Joints.

5. *The Rabbet* PLANE is us'd in cutting the upper Edge of a Board, ſtrait or ſquare, down into the Stuff, ſo that the Edge of another, cut after the ſame Manner, may join in with it on the Square; it is alſo us'd in ſtriking *Facia*'s in Mouldings. The Chiſſel or Iron of this Plane is full as broad as its Stock, that the Angle may cut ſtrait, and it delivers its Shavings at the Sides, and not at the Top, like the others.

6. *The Plow*, a narrow Rabbet Plane, with the Addition of two Staves, whereon are Shoulders. The Uſe of it is to plow a narrow ſquare Groove on the Edge of a Board.

7. *Moulding* PLANES; of theſe there are various Kinds, accommodated to the various Forms and Profiles of the Mouldings; as the *round Plane*, the *hollow Plane*, the *Ogee*, the *Snipes Bill*, &c. which are all of ſeveral Sizes, from half an Inch, to an Inch and a half.

To

To uſe the *Moulding Planes* on ſoft Wood, as Deal, *&c.* They ſet the Iron to an Angle of 45, with the Baſe or Socle of the Plane. On hard Wood, as Box, *&c.* they ſet the Iron to an Angle of 80 Degrees, ſometimes quite upright.

To work on hard Wood, the Edge or Baſil is ground to an an Angle of 18 or 20 Degrees; to work on ſoft Wood, to an Angle about 12, for the more acute the Baſil is, the ſmoother the Iron will cut; but the more obtuſe, the ſtronger.

PLANIMETRY, is that Part of *Geometry* which conſiders Lines and Plain Figures; without any Conſideration of Heights or Depths.

The Word is particularly reſtrain'd to the meaſuring of Planes or Surfaces, in Oppoſition to *Stereometry*, or the meaſuring of Solids.

PLANO *Concave Glaſs* or *Lens*, is that, one of whoſe Surfaces is Concave, and the other Plain.

The Concavity is here ſuppos'd to be ſpherical, unleſs the contrary be expreſs'd.

PLANO *Convex Glaſs* or *Lens*, is that, one of whoſe Surfaces is Convex, and the other Plain.

The Convexity of this is ſuppos'd to be ſpherical, unleſs the Contrary be expreſs'd,

PLASTER } A Compoſi-
PLAISTER } tion of Lime ſometimes with Hair, ſometimes with Sand, *&c.* for Pargeting or Covering over the Nakedneſſes of a Building.

PLASTER *of Paris*, is a Foſſil Stone, of the Nature of a Lime-Stone, ſerving to many Purpoſes in Building, and is alſo us'd in Sculpture, in moulding and making of Statues, Baſſo Relievo's, and other Decorations in Architecture.

It is dug out of Quarries, in ſeveral Places near *Paris*, whence it takes its Name; the fineſt of it is that of *Montinartre*.

Crude PLASTER of *Paris*, is the Native as it comes out of the Quarry, in which State it is us'd, as Hards in the Foundation of Buildings.

Burnt PLASTER is the Native calcin'd like Lime in a Kiln or Furnace, pulveriz'd or diluted with Water or other Liquid in working it. In this State it is us'd as Mortar or Cement in Building.

It being well ſifted and reduc'd to an impalpable Powder, it is us'd in making Figures in Sculpture.

PLASTICE or *Plaſtic Art*, a Branch of Sculpture, being the Art of forming Figures of Men and other Animals, in Plaſter, Clay, Stuc, *&c.*

It is not only comprehended under Sculpture, but is indeed Sculpture it ſelf; but with this Difference, that the Plaſterer or *Plaſtee* (by his *Plaſtic Art*) makes Figures by Additions, but the Carver by Subtraction, whereupon *Michael Angelo* was wont to ſay (pleaſantly) that Sculpture was nothing but a Purgation of Superfluities; for take away from a Piece of Wood or Stone, all that is ſuperfluous, and the Remainder is the intended Figure.

The

The *Plastic Art* is now chiefly us'd among us in Fret-Work Ceilings; but the *Italians* apply it to the Mantlings of Chimneys with great Figures, a cheap Piece of Magnificence, and almost as durable within Doors, as harder Forms in the Weather.

PLAT-BAND [in *Architecture*] says M. *Perrault* is any flat square Moulding, having less Projecture than Height; such are the Faces or Fasciæ of an Architrave, and the *Plat-Bands* of the Modillions of a Cornice.

These *Plat-Bands* are ordinarily cross'd with Bars of Iron, when they have a great *Bearing*; but it is much better to ease them by Arches of Discharge built over them.

PLAT-BANDS *of Flutings* are the Lists or Fillets between the Flutings of the *Ionic*, *Corinthian* and *Composite* Columns, they are each in Breadth $\frac{1}{4}$ of the Flute.

Plat-Bands are also a square Moulding, set at the End of the Architrave of the *Doric* Order.

The *Plat-Band* is signified by *Vitruvius* by the Words, *Fascia*, *Tænia* and *Corsa*.

PLAT-FORM [in *Architecture*] is a Row of Beams which support the Timber Work of a Roof, and lie on the Top of the Wall, where the Entablature ought to be rais'd.

The Term is also us'd for a kind of Terras Walk or even Floor on the Top of a Building; from whence we may take a fair Prospect of the adjacent Country.

So an Edifice is said to be cover'd with a Platform when it is flat at Top, and has no arched Roof or Ridge.

Platform is sometimes us'd to signify the Ichnography or Draught of the Ground-Plot of an House.

Most of the Eastern Buildings are covered with *Platforms*, as also were those of the Ancients. *Cæsar* is said to have been the first among the *Romans* who obtain'd leave to build his House with a Ridge or Pinnacle.

PLATFOND is a *French* Word, us'd for the Ceiling or Roof of a Chamber or other Room. The same as *Soffit*.

PLATONICK BODIES, the same that are otherwise call'd *Regular Bodies*.

PLINTH [in *Architecture*] is a flat square Piece or Table in Form of a Brick (from πλίνθος in Gr. signifying a Brick) under the Mouldings of the Bases of Columns and Pedestals.

It is us'd as the Foot or Foundation of Columns, seeming to have been originally intended to prevent the Bottom of the Primitive wooden Pillars from rotting.

The *Plinth of a Statue* is a Base or Stand, either flat, round or square, serving to support a Statue.

Plinth of a Wall is a Term us'd by Bricklayers for two or three Rows of Bricks, which advance out from the Wall, or it is us'd in the General for every flat, high Moulding, serv-

ing in a Front Wall to mark the Floors, or to ſuſtain the Eaves of a Wall, and the Larmier of a Chimney.

Vitruvius calls the *Tuſcan Abacus* Plinth, on Account of the Reſemblance it bears to a Brick: It is alſo call'd *Orlo*.

PLUMB LINE, a Name given by Artificers to a *Perpendicular*, it is thus call'd, becauſe uſually deſcrib'd by Means of a Plummet.

PLUMBERY, See *Lead*.

PLUMMET, PLUMB RULE, PLUMB LINE, is an Inſtrument us'd by Carpenters, Maſons, to draw Perpendiculars withal, in Order to judge whether Walls, &c. be upright Planes, horizontal and the like.

It is thus call'd from *Plumbum*, i. e. a Piece of Lead, faſtened to the End of a Thread or Chord.

Sometimes the String deſcends along a wooden Ruler, &c. rais'd perpendicular on another; in which Caſe it becomes a Level.

POINT [in *Geometry*] is that which is ſuppos'd to have neither Breadth, Length nor Thickneſs; but to be indiviſible.

1. The Ends or Extremities of Lines are Points.

2. If a Point be ſuppos'd to be mov'd any Way, it will by its Motion deſcribe a Line.

POINT [in *Perſpective*] is a Term us'd for various Parts or Places, with Reſpect to the Perſpective Plane.

Objective POINT, is a Point on a Geometrical Plane, whoſe Repreſentation is required on the Perſpective Plane.

POINT *of Concourſe*, POINT *of Concurrence* [in *Opticks*] is that Point where the viſual Rays, being reciprocally inclin'd, and ſufficiently prolonged, meet together, are united in the middle, and croſs the Axis. This Point is moſt uſually call'd the *Focus*, and ſometimes the *Point of Convergence*.

POINT *of Diſperſion*, is that wherein the Rays begin to diverge, which is uſually call'd the *Virtual Focus*.

POINT *of Incidence* is a Point on the Surface of a Glaſs or other Body, wherein a Ray of Light falls; and as ſome expreſs it, is that Point of a Glaſs from which a Ray parts after its Refraction, and when it is returning into the rare Medium again.

POINT *of View*, with Reſpect to Building, &c. is a Point at a certain Diſtance from a Building or other Object, wherein the Eye has the moſt advantageous View or Proſpect of the ſame.

This *Point* is uſually at a Diſtance equal to the Height of the Building, as for Inſtance, To examine with Judgment the whole of the celebrated Church of the *Invalids* at *Paris*, a Perſon muſt not ſtand at above 340 Foot diſtant from it, which is pretty near its Height.

To be able to judge of the Ordonnance of its Facade and Frontiſpiece, and the Regularity of its Order, the Eye ſhould be as far off as the

Fron-

Frontiſpiece is high, *viz.* 100 Foot.

But to examine the Correctneſs of its Profiles, and the Spirit of its Ornaments, the Eye ſhould only be diſtant the Height of the *Doric* Order, which is about 40 Foot; if it be nearer, the Parts being too much ſhorten'd, will appear out of Proportion.

A vague or indeterminate Point has a different Effect from the *Point of View*, in that, in looking at a Building from an indeterminate Point; the Eye can only form an Idea of the Magnitude of its Maſs, by comparing it with other Buildings adjacent to it.

POINT *of Reflection*, is a Point on the Surface of a Glaſs or other Body, whence a Ray is reflected.

POINT *of Refraction*, is a Point in the Surface of a Glaſs or other reflecting Surface, wherein the Refraction is effected.

POITRAL, See *Architrave.*

POLYGON [in *Geometry*] A term in the General ſignifying any Figure of many Sides and Angles, tho' no Figure is call'd by that Name, except it have more than four or five Sides.

If the Sides and Angles be equal, the Figure is call'd a Regular Polygon. Polygons are diſtinguiſh'd according to the Number of their Sides; thoſe of five Sides, are call'd *Pentagons*, thoſe of 6, *Hexagons*, thoſe of ſeven, *Heptagons*, thoſe of eight, *Octagons*, &c.

Euclid demonſtrates theſe which follow.

1. Every Polygon may be divided into as many Triangles as it has Sides.

2. The Angles of any Polygon taken together, will make twice as many Right ones, except 4, as the Figure has Sides,

3. Every Polygon circumſcrib'd about a Circle, is equal to a Rectangled Triangle, one of whoſe Legs ſhall be the Radius of a Circle, and the other the Perimeter or Sum of all the Sides of the Polygon.

POLYGRAM is a Geometrical Figure, conſiſting of many Lines.

POLYHEDRON [in *Geometry*] is a Body comprehended under ſeveral Faces or Sides; ſuch are all the five Regular Bodies.

POLYHEDRON [in *Opticks*] is a Glaſs or *Lens*, conſiſting of ſeveral plain Surfaces, diſpos'd into a Convex Form, popularly call'd a *Multiplying Glaſs.*

POLYHEDROUS FIGURE [in *Geometry*] is a Solid contain'd under, or conſiſting of many Sides, which if they are regular Polygons, all ſimilar and equal, and the Body be inſcribable within the Surface of a Sphere, 'tis then call'd a Regular Body.

POLYOPTRUM [in *Opticks*] a Glaſs through which Objects appear multiply'd, but diminiſh'd. It differs both in Structure and Phænomena.

POLYSCOPES or multiplying Glaſſes, are ſuch as repreſent to the Eye one Object as many.

PORCH [in *Architecture*] a

a kind of Veſtible ſupported by Columns, much us'd at the Entrance of the ancient Churches.

In the ancient Architecture *Porch* was a Veſtible or Diſpoſition of inſulatea Columns, uſually crown'd with a Pediment, forming a Covert Place before the principle Door of either a Temple or Palace.

When they had four Columns in Front, they were call'd *Tetraſtyles*, when 6, *Hexaſtyles*; when 8, *Octoſtyles*; when 10, *Decaſtyles*, &c.

PORIME } [in *Geometry*]
PORIMA } is a Theorem or Propoſition, ſo eaſy to be demonſtrated, that it is almoſt Self-evident, as that a Chord is all of it within the Circle.

And on the Contrary, they call that an *Aporime*, which is ſo difficult as to be almoſt impoſſible to be demonſtrated; as the ſquaring of any aſſign'd Portion of *Hippocrates*'s *Lunes* was till lately.

PORISTICK *Method* [in *Mathematicks*] is that which determines when, by what Way, and how many different Ways a Problem may be reſolv'd.

PORPHYRY, a precious kind of Marble, of a browniſh red Colour, frequently interſpers'd with white Stains, anciently brought from *Egypt*, and exceeding all other in hardneſs.

The Art, which the Ancients had, of cutting *Porphyry*, ſeems to be intirely loſt. And indeed it is hard to conceive what kind of Tools they muſt have us'd for faſhioning of theſe large Columns, and other Works in Porphyry, found in the City of *Rome*.

One of the moſt conſiderable Pieces that now remains intire, is a Tomb of *Conſtantia*, Daughter of the Emperor *Conſtantine*, in the Church of St. *Agnes*, without the Walls; commonly call'd the Tomb of *Bacchus*, becauſe of ſeveral Boys repreſented upon it playing among the Vine Leaves. And that of *Appollo*, and the Buſts of 12 Emperors, all of *Porphyry*, in the Palace of the *Tuilleries*.

Some of the ancient Pieces ſeem to have been wrought with a Chiſſel, others with the Saw, others, with Wheels, and others ground by Degrees with Emery.

Yet the modern Tools will ſcarce touch *Porphyry*, ſo that it may be concluded, either that the Ancients had the Secret of tempering Steel better than we now have, or that as ſome imagine, they had the Art of ſoftening the *Porphyry*. But it is rather more probable, that Time and the Air have contributed to increaſe its hardneſs.

Mr. *Addiſon* informs us, he ſaw a Workman in *Rome*, employ'd in the cutting of *Porphyry*; but his Advances were exceeding ſlow, and almoſt inſenſible.

The only Way the *Italian* Sculptors have of working the Pieces of old *Porphyry* Columns that are ſtill remaining (for the *Porphyry* Quarries are long ſince loſt) is with a Braſs

Saw

Saw without any Teeth. With this together with Emery and Water, they rub and wear it with infinite Patience.

Many Perſons have endeavoured to retrieve the ancient Art, particularly *Leon Baptiſta Alberti*, who ſearching after the neceſſary Temper, tells us he found Goat's Blood the beſt of any; but yet even this avail'd but little; for in working with Chiſſels tempered herein, Sparks of Fire came more plentifully than Pieces of the Stone.

By this Means Sculptors were able to make a flat or oval Form; but could never attain to the making any Thing like a Figure.

It is indeed reported that *Coſmo de Medici*, in the Year 1555, diſtill'd a Water from certain Herbs, by the Help of which his Sculptor, *Franciſco Tadda* gave his Tools ſuch an admirable Hardneſs, that he perform'd ſome fine Works with them; particularly our Saviour's Head in *Demi-Relievo*, *Coſmo*'s Head, and his Dutcheſſes. Even the very Hair and Beard, which were very well done, how difficult ſoever it was; ſo that there is nothing better in all the Works of the Ancients: but the Secret ſeems to have died with him.

The *French* have lately found out another Method of cutting *Porphyry*, *viz.* with an Iron Saw without Teeth, and *Gres*, or a kind of Free-Stone, pulveriz'd and Water.

The Authors of this Invention, pretend they could perform the whole Contour of a Column hereby, had they Matter to work on.

PORTAL, [in *Architecture*] a little ſquare Corner of a Room, cut off from the reſt of the Room, by Wainſcot; frequent in the antient Buildings; but now diſus'd.

It is alſo us'd for a little Gate, where there are 2 Gates of a different Bigneſs: It alſo ſometimes ſignifies a kind of Arch of Joiners Work before a Door.

PORTAIL, [in *Architecture*] ſignifies the Face or Frontiſpiece of a Church, view'd on the Side, wherein the great Door is; Alſo the great Door of a Palace, Caſtle &c.

PORTICO, [in *Architecture*] is a kind of Gallery built on the Ground; or a Piazza encompaſs'd with Arches, ſupported by Columns, where People walk under covert.

The Roof is commonly vaulted. This was by the Antients call'd Lacunar.

Altho' the Word *Portico* be deriv'd from *Porta i. e.* a Gate or Door, yet it is apply'd to any Diſpoſition of Columns which form a Gallery; without any immediate relation to Doors or Gates.

The moſt celebrated Portico's of Antiquity were thoſe of Solomon's Temple, which form'd the *Atrium* and encompaſs'd the Sanctuary; that of *Athens*, built for the People to divert themſelves in; and wherein the Philoſophers held their Diſputations and Converſations, which

which was the Occasion of the Greek *Stoicks* of *στοα* Gr. a *Portico*: and that of *Pompey* at *Rome*, erected merely for Magnificence; consisting of several Rows of Columns, supporting a Platform of vast Extent, a Design of which *Serlio* presents us with in his *Antique* Buildidgs.

Among the Modern *Portico's* the most celebrated is the *Piezza* of *St. Peter* of the *Vatican*; that of *Covent Garden*, the Work of *Inigo Jones*, is also much admired.

M. *Le Clerc* says, tho' we have but few Instances of *Arches* or *Porticos* supported by Columns, yet nothing hinders but that they may be us'd where the Architecture is not requir'd to be very strong, as in a plain open Gallery, serving for a Passage or Communication between two Parts of an House, or where 'tis desired to have a slight Terrass in the Front of a Building and a Gallery or Portico underneath.

In a Portico of this Kind, he would have nothing but the Archivolte upon the Column; the Corniche should be plac'd over the Archivolte.

PORTRAIT, PORTRAITURE, } [in *Painting*] the Representation of a Person and especially a Face done from the Life.

PORTLAND *Stone*, Slabs of *Portland* Stone (ready polish'd for Chimney Foot Paces) 1 *s.* 8 *d.* per Foot superficial. It is a Stone much us'd in Building, and much softer and whiter than *Purbeck*.

PORT-NAILS, see *Nails*.

POSTS, [in *Building*] pretty big Pieces of Timber, plac'd upright in Houses &c.

PRINCIPAL Posts, are the Corner Posts of a House, and the Posts fram'd into Bresummers, between the principal *Prick-Posts* for strengthening the Carcass of a House.

A *Method* of *Preserving Posts*] It is a very excellent Method of preserving Posts from rotting, to burn the Ends of them that are to be set into the Ground.

POST and RAIL, see *Fencing* and *Paleing*.

POUND NAILS, see *Nails*.

POUDERINGS, [in *Architecture*] a Term sometimes us'd for Devices, in filling up vacant Spaces in carv'd Work.

PRICK-POST. see *Posts*.

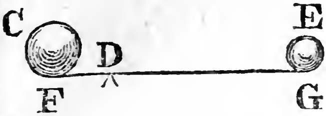
POWERS, [in *Mechanicks*] is *whatever can move a heavy Body*, and is therefore call'd the *moving Force*, thus Weight is a Power in Reference to a heavy Body, which it may move.

Power is twofold, that is, either *animate* as the Power of Men, Horse &c, in pulling, drawing &c, or *inanimate*, as the specifick Gravity of a Body of Gold, Iron, Stone, Water &c, as one Pound two Pounds &c of Weight.

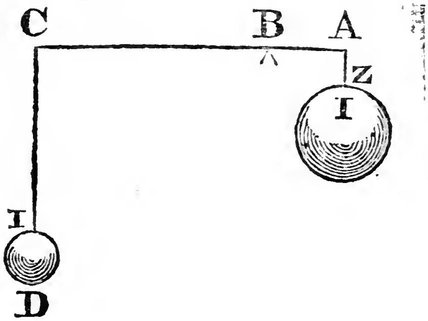
The Quantity of Power is estimated by the Quantity of Weight of the Body which it sustains, that is, when a Power sustains twice or thrice its own Weight; then we say that that Power is double or triple that Weight which it doth sustain.

2. The Manner of applying a Power to a *Lever* may be immediatly on the *Lever*, as the Weight

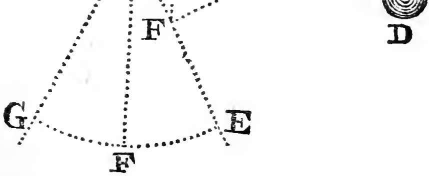
Weight E laid on the End of the *Lever* G F.



Or at ſome Diſtance from it, as the Weight D hung on the Point C, by Means of the Chord D C and that right Line in which a Power or heavy Body endeavours to move in, is call'd the Line of Direction of that Body: So C I is the line of Direction of the Body D, and A Z of the Weight I.



The real Application of a *Power* to a *Lever* is that Angle, which is conſtituted by a *Lever* and *Line of Direction* at their Point of meeting: thus the Angle A B E conſtituted by the line of Direction E B and the *Lever* A B is the Application of the Power E: So likewiſe are the Angles A B F and A B G Applications of the *Powers* F and G.



The Power F, which is apply'd to the Lever B at Right Angles, hath the greateſt Effect, not only of the other two Powers E and G, but of all others that are not Perpendicular to the Lever A B.

The Proof.

1. The Diſtance of a Weight, or a Power from the *Fulcrum* is the neareſt Diſtance contain'd between the *Fulcrum* and the

the Line of Direction; that is, it is a Right Line or Perpendicular let fall from the *Fulcrum* upon the Line of Direction, as C F on the Line of Direction B E.

2. If you describe the Arch F B, on C, with the Radius C F, it is evident that C K is less than C B, and the Point K is nearer to the *Fulcrum* C than the Point B; and since that the farther the Power is apply'd from the *Fulcrum*, the greater Force it will have: Thence it is evident that the Power F, which acts upon the Part of the Lever B, must have greater Force than the Power E, whose Distance from the *Fulcrum* is = C K, which is less than C B.

But if it shall be suppos'd from hence, that the lesser the Angle of Application is, the greater the Power must be increas'd to become equal to the Power F, and that the greater the Angle of Application is made, as the Angle C B G, the lesser the Force is requir'd to be equal to the Power F.

I answer that the first Supposition upon the Powers apply'd with Angles acute is right; but the Supposition of the Obtuse Angles requiring a lesser Force to equalize F is false, which I shall prove as follows.

1. It has been said already, that the Distance of a Power from the *Fulcrum*, is a Right Line or Perpendicular, let fall from the *Fulcrum* upon the Line of Direction.

2. Since the Lever C B is the Perpendicular it self to the Line of Direction B F of the Power E, whose Angle C B F is a Right Angle, it is evident that if the Power F be remov'd to G, then the Angle C B G will be an obtuse Angle.

And seeing that when any Right-lin'd Triangle hath one of its Angles obtuse, the Sum of the other two must be less than a Right Angle; because the Sum of all the three Angles taken together, are always equal to two Right Angles, or 180 Degrees.

3. Now the Angle C B G, being an obtuse Angle, it is impossible that a Line can be drawn from the *Fulcrum* C to the Line of Direction B G, and to be perpendicular to it too.

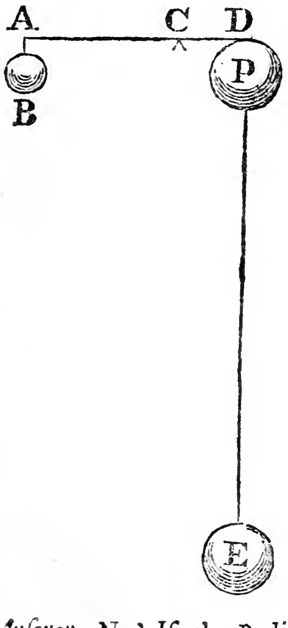
But to supply this Defect, you must continue on the Line of Direction G B, through the Point of Application B, upwards towards H; and then if a Perpendicular be let fall from the *Fulcrum* C, to the continued Line of Direction B H, it will cut the Line B H in H, then C K.

4. If the Distance of the Power G from the Power F be equal the Distance of the Power E from the Power F, then will the Perpendicular C H be equal to the Perpendicular C E, and therefore the Power apply'd at G, whose obtuse Angle C B G exceeds the Right Angle C B F, as much as the acute Angle C B E is less than the Right Angle C B F is equal in Force to the Power E, and both less in Force than the Power E, which was to be demonstrated.

Hence

Hence it is evident, that if the Power G was to thruſt or preſs at H on B, its Force would be the very ſame, as when pulling at G, and that when Workmen apply their Strength to raiſe up heavy Weights, they ſhould always endeavour to apply the ſame as near to a Right Angle with a Lever, as they poſſibly can.

Queſtion. Has not a Power as P, being hung cloſe to the *Lever* A D, a greater Force than when hung on the ſame Point D at the End of a long Cord or Line, as the Weight E?



Anſwer. No? If the Bodies P and E are equal, the Body E will have the ſame Force as the Body P, and if the Gravity or Weight of the Cord be conſidered and added to it, it will have a greater Force than the Body P, for were the Weight E to be ſuſtain'd by the End of the Cord at D, both their Weights muſt be ſuſtain'd at the ſame Time.

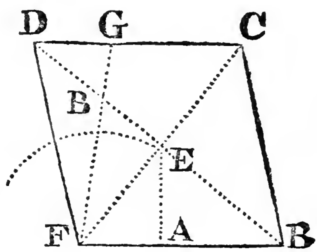
As to the natural Deſcent of heavy Bodies and of their Line of Direction, in which they endeavour to deſcend,

A heavy Body naturally deſcends to the loweſt Place it can go, provided that its Deſcent is not oppos'd by any other heavy Body.

And as all the Parts of *Homogeneous* Bodies have an equal Preſſure about their Centres of Gravity, therefore the chief Endeavour of Bodies to deſcend, is made by the Deſcent of their Centres of Gravity.

For if the Centre of Gravity of a Body do not deſcend, but remain fix'd, the whole Body will remain fix'd alſo; becauſe it is to the Centre of Gravity, that all the Parts of the Body have a cloſe Adherence.

Hence it is plain, that the inclin'd Body C D B A cannot fall towards F, which it inclines to, becauſe its Centre of Gra-

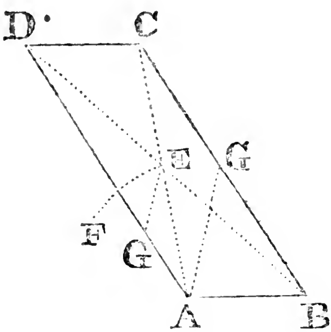


vity E, muſt be obliged to aſcend and paſs through the Arch

 E P,

E P, which it cannot do, the Part or Quantity G C A B ſtanding over the Baſe, wherein the Centre of Gravity is, being greater than the inclining Part G D A.

Therefore it is evident, that no ſuch Body can deſcend, when the Line of Direction or Centre of Gravity doth not exceed the Extremes of the Baſe B A.



And on the Contrary, when the Centre of Gravity of an inclin'd Body, as E exceeds the Limits of the utmoſt Perpendicular, as G A, whereby the Part ſtanding over the Baſe G B A is leſſer than the inclining Part G A C D: Then ſuch Bodies will fall, for the Centre of Gravity E, having A for its Centre, will freely deſcend in the Arch E F.

Now 'tis very plain, that to have a Body remain ſtedfaſt upon its Baſe, and not inclin'd, the Line of Direction muſt of Neceſſity fall in ſome Part of the Baſe of the ſaid Body, or otherwiſe it will naturally fall.

Whence it follows, that the leſſer the Baſe of any upright Body is, the eaſier it will move out of its Poſition; becauſe the leaſt Change is capable of moving the Line of Direction out of its Baſe.

This is the Cauſe why a Ball or Sphere, whoſe Baſe is a Point only, rolls eaſily on a plain Superficies, by a gentle Force.

The Law of Mechanicks is obſerv'd by every Animal, in their riſing and ſtanding, to prevent their falling; as for Example in human Bodies, when we are to riſe from a Seat we naturally bend our Bodies forward, ſo as to cauſe the Line of Direction of our Bodies to paſs through our Feet, upon which we bear our ſelves when we begin to aſcend.

Now from the preceeding it follows, that the wider the Baſe of any Body is, the eaſier it will ſupport it ſelf, becauſe then the Line of Direction cannot go out of the Baſe without greater Force.

This being well underſtood, will be of very great Service to Painters, Carvers and Statuaries, in giving their Figures ſuch

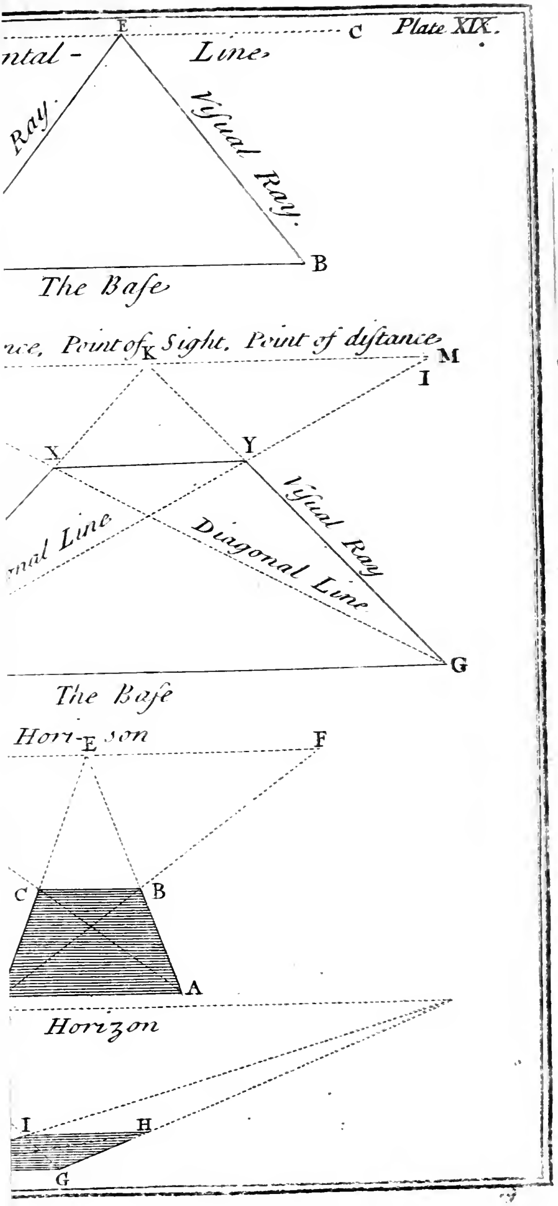


Plate XIX.
E
C
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Line
Ray
Visual Ray
B
The Base
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K
Sight. Point of distance
M
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The Base
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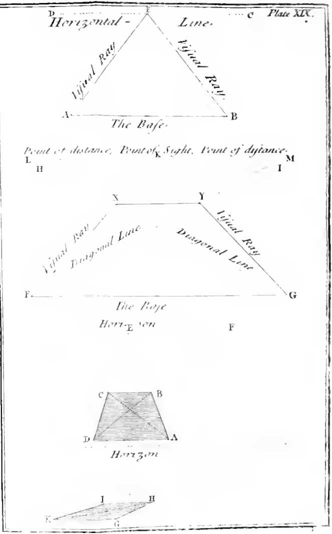


Plate XIX.
D
F
C
Horizontal - Line.
Visual Ray
Visual Ray
A
B
The Base.
Point of distance, Point of Sight, Point of distance.
L
K
M
H
I
X
Y
Visual Ray
Diagonal Line
Diagonal Line
Visual Ray
F
G
The Base
Horizon
E
F
C
B
D
A
Horizon
I
H
K
G

ſuch Poſtures as are agreeable to Nature; as alſo to Maſons, Bricklayers, *&c.* in proportioning the Thickneſs of Walls, according to their ſeveral Heights requir'd.

It is worthy Notice, that all the Powers or Bodies produc'd are ſuch as equipoiſe each other, or are equal in Power to each other, according to their ſeveral Ratio's. And therefore,

Take Notice, that when a Power can ſuſtain a Weight, by the Means of any Ballance, Lever, *&c.* a Power greater, as little as can be imagin'd, will over-poiſe, or cauſe the ſaid Weight to riſe.

Likewiſe take Notice, that the Weight of the Levers, Pullies, *&c.* and their Friction is not conſider'd, a Lever being conſider'd as a Right Line, and a Pully as moving on a real Point.

N.B. *The Copy of the following Articles in* POINT *and* POLYGON, *being miſplac'd, and not coming Time enough to be put into the laſt Sheet, we inſert it in this.*

POINT *of Sight*, POINT *of the Eye*, *Principal* POINT, *Perſpective* POINT [in *Perſpective*] is a Point in the Axis of the Eye, or in the Central Ray, where the ſame is interſected by the Horizon.

Thus the Point E is the Point of Sight in the Horizon C D, wherein all the viſual Rays meet. It is call'd the *Point of the Eye*, or *ocular Point*, becauſe directly oppos'd to the Eye of the Perſon, who is to view the Piece. See *Plate* Fig. 1.

POINT or POINTS of *Diſtance* [in *Perſpective*] is a Point or Points (for there are ſometimes two of them) plac'd at equal Diſtance from the Point of Sight. They are thus denominated by Reaſon that the Spectator ought to be ſo far remov'd from the Figure or Painting, and the Terreſtial Line, as theſe Points are from the Point of the Eye, and are always to be in the Horizontal Line.

Thus H I being the Horizon and K the Point of Sight, L and M are Points of Diſtance, ſerving to give all the Shortenings. See the *Plate* Fig. 2.

Thus *ex. gr.* If from the Extremes of the Line F G you draw two Lines to the Point K, and from the ſame Points draw two Lines to the Points of Diſtance M and L, where theſe two Lines G L and F M cut the Lines F K and G K in the Point, X and Y will be the Line of Depth, and the Shortening of the Square, whereof F G is the Side and Baſe. The Lines drawn to the Point of Sight, are all viſual Rays, and thoſe drawn to the Points of Diſtance, are all Diagonals. See *Plate* Fig. 2.

Accidental POINTS, *Contingent* POINTS [in *Perſpective*] are certain Points, wherein ſuch Objects as may be thrown negligently and without Order under the Plan, do tend

tend to terminate. For this Reaſon they are not drawn to the Point of Sight, nor the Points of Diſtance, but meet accidentally or at Random in the Horizon.

POINT of the FRONT [in *Perſpective*] is when we have the Object directly before us; and not more on one Side than the other, in which Caſe it only ſhews the Foreſide, and if it be below the Horizon, a little of the Top too, but nothing of the Sides, unleſs the Object be Polygonous.

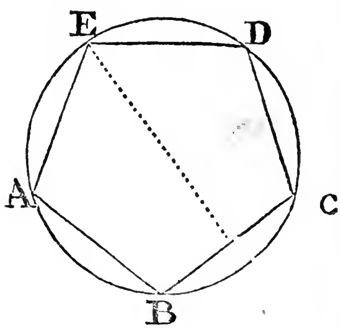
Thus the Plan A B C D, is all Front, and if it were rais'd, we ſhould not ſee any Thing of the Sides A B or C D, but only the Front A D: The Reaſon is, that the Point of View E, being directly oppoſite thereto, cauſes a Diminution on each Side; which however is only to be underſtood where an Elevation is the Object; for if it be a Plan, it ſhews the whole, as A B C D. See the *Plate* Fig. 3.

Side POINT. The Point of OBLIQUE VIEW, or of the SIDE, is when we ſee the Object aſide of us, and only as it were aſlant or with the Corner of the Eye; the Eye however being all the while oppoſite to the Point of Sight; in which Caſe we view the Object laterally, and it preſents us two Faces or Sides.

For Inſtance, if the Point of Sight be in F, the Object G H I K, will appear athwart, and ſhew two Faces G K, and G H, in which Caſe it will be a Side Point. The Practice is the ſame in the Side Point, as in the Front Points; a Point of Sight, Points of Diſtance, &c. being laid down in the one as well as the other. See *Plate* Figure 4.

To deſcribe any Regular POLYGON, *ſuppoſe the* PENTAGON A B C D E.

Divide the Circumference of the Circle, *viz.* 360 Degrees, by (5) the Number of Sides, contain'd in the Polygon, and the Quotient will be the Number of Degrees contain'd in the Arch of one Side.



So 360 being divided by 5, the Quotient will be 72.

Then taking 72 Degrees from your Line of Chords, ſet that Diſtance from A to B, from B to C; from C to D; from D to E, and from E to A, and then join A B, B C, C D, D E and E A, the Polygon required.

Regular POLYGONS are all ſuch Figures as have more than four Sides; all the Sides and Angles of them being equal. *Polygons*, are denominated from the Number of their Sides and Angles.

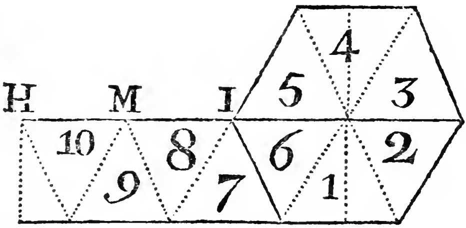
If

If the Figure consists of		Equal Sides and Angles, it is call'd a Regular	
	5		Pentagon.
	6		Hexagon.
	7		Heptagon.
	8		Octagon.
	9		Enneagon.
	10		Decagon.
	11		Endecagon.
	12		Dodecagon.

Polygon. *Every Polygon is equal to a Parallelogram, whose Length is equal to half the Perimeter or Circumference thereof, and Breadth to a Perpendicular drawn from the Centre to the middle of any Side of the same.*

Let the Hexagon I D H L O P, be the given Polygon, and E N a Perpendicular, drawn from the Centre N, to the middle of the Side D H.

2. Draw Right Lines from the Centre N, to the Angles I D H L O P: also continue E D to A, making E A equal to half the Perimeter of the *Polygon*; that is, make D C equal to H L; C B equal to L O; and H A, equal to E H, then compleat the Parallelogram A E K N, and make I M and M K equal to I N.



Now I say, that the Parallelogram A E K N, whose Length A E is equal to half the Circumference of the Polygon, and Breadth to the Perpendicular E N, is equal to the Polygon D H L O P I. For as the Triangles 1, 2, 3, 4, 5, 6, are all equal to one another; so also are the Triangles, 7, 8, 9 and 10, equal thereto also, because they are all of equal Bases and between the same Parallels A H and K L.

Now seeing that the Triangles D N E, and D I N are already compris'd within the Parallelogram A E K N, it only remains to prove that the Triangles 7. 8, 9, 10, and A B K, are equal to the remaining Triangles of the Polygon E N H, 2, 3, 4 and 5.

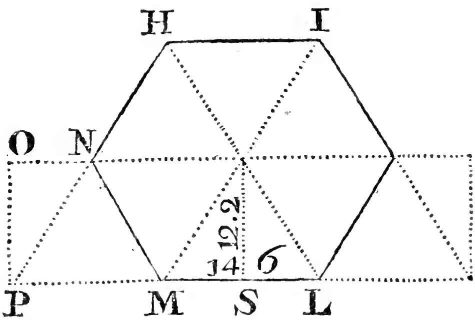
It has been already prov'd, that the several Triangles 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 are equal to one another; therefore the Triangle 7, may be said to be equal to the Triangle 5; the Triangle 8, to the Triangle 4,

the Triangle 9, to the Triangle 3, the Triangle 10, to the Triangle 2; and lastly, the Triangle A B K to the Triangle E N H; therefore is the Parallelogram A E K N equal to the Polygon I D H L O P. Q. E. D.

Corollary.

Hence appears the Reason of the general Rule for the Mensuration of Polygons, to multiply half the Circumference by a Perpendicular, let fall from the Centre upon one of the Sides.

To find the Area or Superficial Content of any Regular Polygon.



14.6
3

43 . 8 half Sum of the Sides.

12.64 the Perpendicular.
43 . 8 half Sum.

10112
3792
5956

553.632 Area.

14.6
6

87.6
63.2

1752
2628
5256

553.632 Area.

Let H I K L M be a Regular Hexagon, each Side thereof being 14.6, the Sum of all the Sides is 87.6 the half Sum is 43.8, which being multiply'd by the Perpendicular S, 12, 64 the Product is 553.63. : or if 87.6, the whole Sum of the Sides be multiply'd by half the Perpendicular 6.32 the Product will be 553.63 the same as before, which is the Area of the given Hexagon.

By

By Scale and Compasses.

Extend the Compasses from 1 to 12.2, that Extent will reach from 43.8, the same Way to 553.63: or extend the Compasses from 2 to 12. That Extent will reach from 87.6, to 553.63.

Demonstration.

Every Regular Polygon, is equal to the Parallelogram or long Square, whose Length is equal to half the Sum of the Sides and Breadth equal to the Perpendicular of the Polygon, as appears by the preceeding Figure; for the Hexagon H I K L M N is made up of six equilateral Triangles, that is five whole ones and two halves; therefore the Parallelogram is equal to the Hexagon.

A Table for the more readily finding the Area of a Polygon.

Number of Sides.	Names.	Multipliers.
3	Trigon	.433013
4	Tetragon	1.000000
5	Pentagon	1.720477
6	Hexagon	2.598076
7	Heptagon	3.633959
8	Octagon	4.828427
9	Enneagon	6.181827
10	Decagon	7.694209
11	Endecagon	8.514250
12	Dodecagon	9.330125

Multiply the Square of the Side by the Tabular Number, and the Product will be the Area of the Polygon.

PRIME *Numbers* [in *Arithmetick*] are those made only by Addition or the Collection of Unites, and not by Multiplication, so an Unite only can measure it, as 2, 3, 4, 5, &c. and is by some call'd a *simple*, and by others, an *uncompound Number*.

PRIME *Figure* [in *Geometry*] is that which cannot be divided into any other Figures more Simple than it self; as a Triangle into Planes, a Pyramid in Solids; for all Planes are made of the first, and all Bodies or Solids are compounded of the Second.

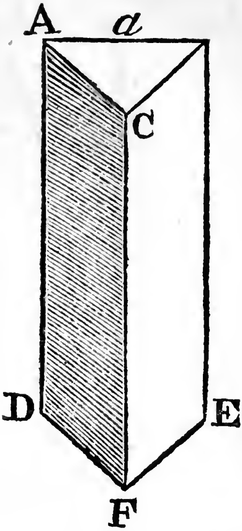
PRIMING [in *Painting*] is the laying on of the first Colour.

PRINCIPAL *Point*, [in *Perspective*] is a Point in the Perspective Plane, upon which a Line drawn from the Eye, perpendicular to the vertical Plane; or it is that Point of a Picture, wherein a Ray, drawn perpendicular to it, cuts it.

PRINCIPAL *Ray* [in *Perspective*] is that which passes perpendicularly from the Spectator's Eye, to the Perspective or vertical Plane.

PRISM is a Solid contain'd under ſeveral Planes, and having its Baſes alike equal and parallel, the Solid Content of a Priſm (whether Triangular or Multangular) is found by multiplying the Area of the Baſe into the Length or Height, and the Product will be the ſolid Content.

Let A B C D E F be a triangular Priſm, each Side of the Baſe being 15. 6 Inches; the Perpendicular of it C *a*, is 13. 51 Inches, and the Length of the Solid, 19. 5.



Multiply the Perpendicular of the Triangle, 13. 15. by half the Sum 7. 8, and the Product will be 105. 378, the Area of the Baſe; which multiply by the Length 19. 5, and the Product will be 2054. 871, which divide by 144, and the Quotient is 14 . 27 Feet *fere*, the Solid Content.

```
   13.51
     7.8
   10808
   9457
  105.378
    19.5
  526890
 948402
105378
2054.8710
```

```
144) 2054.87 (14.27
     144
      614
      576
       388
       288
       1007
       1008
```

By Scale and Compaſſes.

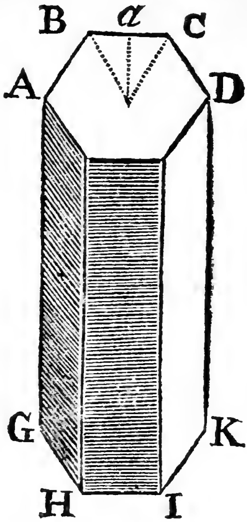
Firſt, Find a mean Proportional between the Perpendicular and half Side, by dividing the Space upon the Line (as taught in the Parallelopipedon) between 13.51 and 7.8, into 2 equal Parts; ſo ſhall you find the middle Point between them to be at 10.26, which is the mean Proportional ſought; by this Means the Triangular Solid, is brought to a ſquare, each Side being 10.26 Inches.

Then extend the Compaſſes from 12 to 10.26; that Extent turn'd twice downwards from 19.5 Feet the Length, will at laſt fall upon 14.27. which is 14 Feet and a little above a quarter.

Hexan-

Hexangular PRISM. Let ABCDEFGHIK, represent a Prism, whose Base is a Hexagon, each Side of which is 16 Inches, and the Perpendicular from the Centre of the Base to the middle of one of the Sides *(a b)* is 13.84 Inches, and the Length of the Prism is 15 Feet; the Solid Content is requir'd.

Multiply half the Sum of the Sides 48 by 13.84, and the Product will be 664.32, the Area of the Hexagonal Base, which multiply by 15 Feet, the Length of the Product will be 9964.8, which divide by 144, and the Quotient will be 69.2 Feet, the Solid Content requir'd.




```
  13.84
     48
  -----
  11072
 5536
  -----
 664.32  Area of the Base.
     15
  -----
 332160
 66432
 -------
 9964.80
```

```
144) 996480 (69.2
     864
     ----
     1324
     1296
     ----
      288
      288
      ---
      000
```

By Scale and Compasses.

First, Find a mean Proportional between the Perpendicular and half the Sum of the Sides, that is, divide the Space between 13.84 and 48, and the middle Point will be 25.77.

Then extend the Compasses from 12 to 25.77; and that Extent will reach (being twice turn'd over) from 15 Feet the Length, to 69.2 Feet the Content.

To find the Superficial Content of any of these Solids, you must take the Girt of the Piece, and multiply by the Length

Length, and to that Product add the two Areas of the Bases, and the Sum will be the whole Superficial Content.

Example. The Hexagonal Prism, the Sum of the Sides being 96, the Product will be 17280 square Inches, to which add twice 664.32 the Area's of the two Bases; and the Sum is 18608.64, the Area of the whole which is 129.22 Feet.

```
   180
    96
  ----
  1080
 1620
 -----
 17280
   664 32
   664 32
 --------
 18608 64
```

```
144) 18608·64 (129.22
     ----
      420
      1328
      ----
       326
        384
        ---
         96
```

The Superficial Content of the whole Solid is 129.22.

By Scale and Compasses.

Extend the Compasses from 144 to 180, and that Extent will reach from 96 to 120 Feet; then to find the Area of the Base, extend the Compasses from 144 to 13·84 and that Extent will reach from 48 to 4.6 Feet; add 120 Feet, and twice 4.6 Feet, and it will make 129.22 Feet, the Superficial Content, as before.

The Demonstration of these Prisms will be the same as in that of the Cube; for as in that, so in those, the Area of the Base is multiply'd into the Length to find the Content, and the same Reason is given for the one, as for the other.

1. PRISM [in *Opticks*] is a Glass bounded with two equal and parallel triangular Ends, and three plane and well polish'd Sides, which meet in three parallel Lines, running from the three Angles of one End to those of the other, and is us'd in Opticks to make many noble and curious Experiments about Light and Colours; for the Rays of the Sun falling upon it at a certain Angle, do transmit thro' it a Spectrum or Appearance, colour'd like the Iris or Rainbow in the Heavens.

2. The Surface of a Right Prism, is equal to a Parallelogram of the same Height, having for its Base a Right Line equal to the Periphery of the Prism.

3. All Prisms are to one another in a Ratio, compounded of their Bases and Heights.

4. All like Prisms are to one another in the Triplicate Ratio of their answerable Sides.

5. A Prism is the Triple of a Pyramid of the same Base and Height.

PRISMOID [in *Geometry*] is a ſolid Figure, bounded by ſeveral Planes, whoſe Baſes are Right angled Parallelograms, parallel and alike ſituated.

PROBLEM [in *Geometry*] is a Propoſition wherein ſome Operation or Conſtruction is required, or it is a Propoſition which refers to Practice, or which propoſes ſomething to be done; as to divide a Line, to conſtruct an Angle, to draw a Circle into three Points, not in a Right Line, &c.

Wolfius ſays a *Problem* conſiſts of three Parts.

1. The Propoſition which expreſſes what is to be done.

2. The Reſolution or Solution, wherein the ſeveral Steps whereby the Thing required is to be effected, are orderly rehearſed.

3. The Demonſtration wherein is ſhewn, that by doing the ſeveral Things preſcrib'd in the Reſolution, the Thing requir'd is obtain'd.

Accordingly the general Tenor of all *Problems* is this, the Things preſcrib'd in the Reſolution being done, the Thing required is done.

To PRODUCE [in *Geometry*] ſignifies to continue a Right Line, or draw it out farther, till it have any aſſigned Length.

PRODUCT [in *Arithmetick*] is the Number ariſing from, or produc'd by the Multiplication of two or more Numbers into one another. Thus if 5 be multiply'd by 4, the Product is 20.

PRODUCT [in *Geometry*] is the Quantity ariſing by the Multiplication of two or more Lines one into another; in Lines it is always call'd the *Rectangle*.

PROFILE [in *Architecture*] is the Figure or Draught of a Building or the like, wherein are expreſs'd the ſeveral Heights, Breadths and Thickneſſes, ſuch as they would appear if the Building were cut down perpendicularly from the Roof to the Foundation, whence the *Profile* is alſo call'd the *Section*, and by *Vitruvius*, *Sciagraphy*.

PROFILE is alſo us'd for the Contour or Out-line of any Member of a Building, as that of the Baſe, a Cornice or the like.

Hence *Profileing* is ſometimes us'd for deſigning or deſcribing the Member with Rule, Compaſs, &c.

PROFILE is us'd for a Proſpect of any Place, City or Piece of Architecture, view'd Sideways, and expreſs'd according to the Rules of Perſpective.

PROFILE is ſometimes us'd for a Deſign or Deſcription; in Oppoſition to a Plan or *Ichnography*. In which Senſe Profile ſignifies the ſame with what we popularly call a Proſpect, as above.

PROFILE [in *Sculpture*, *Painting*, &c.] is us'd of a Head, Portrait, &c. which are ſaid to be in Profile, when they are repreſented Sideways, or with a Side view: As when in a Portrait, there is but one Side of the Face, one Eye; one

Cheek, &c. ſhown, and nothing of the other.

PROJECTILES [in *Mechanicks*] are heavy Bodies put into a violent Motion, by any great external Force impreſs'd thereon; and then caſt off or let go from the Place where they received their Quantity of Motion, and are afterwards moved at a Diſtance from it, as a Stone thrown out of a String, an Arrow from a Bow, a Bullet from a Gun, &c.

PROJECTION [in *Mechanicks*] is the Action of giving a Projectile its Motion.

Monſtrous PROJECTION, See ANAMORPHOSIS.

PROJECTURE [in *Architecture*] ſignifies the Out-jetting, Prominency or Emboſſment, which the Mouldings, and other Members have, beyond the naked Wall, Column, &c. and is always in Proportion to its Height.

The Word is alſo apply'd to Galleries, Balconies, &c. which jet out beyond the Face of the Wall.

Vitruvius gives it as a general Rule, that all *Projecting* Members in Building, have their *Projectures* equal to their Heights. But this is not to be underſtood of particular Members or Mouldings, as Dentils, Corona's, the *Faſciæ* of Architraves, the *Abacus* of the *Tuſcan* and *Dorick* Capital, &c. but only of the Projectures of intire Cornices.

Some modern Architects are of Opinion that the great Point in Building conſiſts in knowing how to vary the Proportions of *Projectures* agreeable to the Circumſtances of the Building.

Thus they ſay the nearneſs and remoteneſs making a difference in the View requires different *Projectures*, but it's plain that the Antients had no ſuch Intention.

M. *Perrault* obſerves that the Projecture of the Baſe and Cornice is greater in the Antique than in the modern Buildings by $\frac{1}{3}$: which ſeems to follow in good Meaſure from the Antients Proportioning the *Projecture* to the Height of the Pedeſtal; whereas the Moderns make the *Projecture* the ſame in all the Orders, tho' the Height of the Pedeſtal be very different.

PROPORTION [in *Arithmetick*] is the identity or ſimilitude of two ratio's.

Arithmetical Proportion, is the equality of two or more arithmetical ratio's, or the equality of difference between three ſeveral quantities.

Geometrical PROPORTION is the equality of two geometrical ratio's or compariſons of two couples of Quantities.

PROSTYLE [*in Architecture*] a range of columns in the front of a Temple.

PROTHYRUM [in *Architecture*] a Porch at the outward door of a Houſe.

PROTHYRIS is alſo uſed by *Vignola* for a particular ſort of a Key of an Arch, an inſtance of which is found in his *Ionick* Order; which conſiſts of a roll of water leaves, between two Riglets and two Fillets, crown'd with a *Dorick Cymatium*; its figure being much like that of a *Modillion*.

PROTHYRIS [in the ancient *Architecture*] is alſo ſometimes uſed for a Quoin or corner of a Wall; and alſo ſometimes for a croſs Beam and overthwart Rafter.

PSEUDO-DIPTERE [in the ancient *Architecture*] a Temple, having eight columns in front, and a ſingle row of columns all around.

PUDLAYS, pieces of ſtuff to do the office of levers or handſpikes.

PULVINATA a Freeze, a ſwelling or bulging out in manner of a Pillow.

PULLEY [in *Mechanicks*] is one of the five mechanical powers, conſiſting of a little wheel or rundle, having a channel round it, and turning on an Axis, ſerving (by means of a rope which ſlides in the channel) for the raiſing of Weights.

In ſeveral caſes where the *Axis* in *Peritrochio* cannot conveniently be apply'd, Pulleys muſt be made uſe of in raiſing weights.

A Machine formd by combining ſeveral of them, lies in a little compaſs, and is eaſily carried about, if the Weight be fixt to the Pulley, ſo that it may be drawn up along with it: Each end of the drawing or running rope ſuſtains half the weight; therefore when one End is fixt either to a Hook or any other Weight the moving force, or power apply'd to the other end of it, if it be equal to half the weight, will keep the weight in equilibrio.

Several ſheaves may be join'd in any manner, and the weight be fixt to them; then if one end of the Rope be fixt, and the Rope goes round all thoſe ſheaves, and as many other fixed ones as is neceſſary, a great weight may be raiſed by a ſmall power.

In that caſe the greater number of ſheaves fix'd in a moveable pulley, or of moveable wheels (for the fixed ones do not change the action of the power) ſo much may the power be leſs which ſuſtains the weight; and a power which is to the weight, as the number one, to twice the number of the Sheaves.

The Doctrine of the Pulley.

If a power P, ſuſtains a weight Q, by means of a ſingle pulley AB, in ſuch manner as that the Line of Direction of each is a tangent to the periphery of the rundle, the weight and the power are equal. See *Plate* Fig. 1.

Hence, a ſingle *Pulley*, if the lines of direction of the power and weight be tangents to the periphery, neither aſſiſts nor impedes the power.

The uſe of the *Pulley* therefore is, when the vertical direction of a power is to be changed into an horizontal one; or an aſcending one into a deſcending one, and on the contrary.

This is found a good proviſion for the ſafety of the workmen employ'd in drawing with the *pulley*: For ſuppoſe a large weight EFg, be required to be rais'd to a great height, by workmen pulling the rope AB: if

if now the rope ſhould chance to break, the workmens heads underneath would be in immediate danger; but if by means of the pulley B, the vertical direction AB, be changed into a horizontal one BC, there is no danger from the breaking of a Rope. This change of direction by means of a pulley, has this advantage further, that if any power can exert more force in one direction than another, we may be here able to employ it in the greateſt force. See *Plate* Fig. 2.

Thus for Example, a horſe cannot draw in a vertical direction; but draws with all its advantage in a horizontal one; therefore by changing the vertical draught into a horizontal one, a horſe becomes qualified to raiſe a weight.

2. If a power apply'd in G, according to the line of direction BE, which is a tangent to the pulley in E, and parallel to the rope AD, ſuſtain the weight F, ſuſpended from the center of the pulley G, the power is ſubduple of the weight. See *Plate* Fig. 3.

But the grand uſe of the pulley, is where ſeveral of them are combin'd; thus forming what *Vitrivus* and others after him call *Polyſpaſta*; the advantages whereof are, that the machine takes up but little room, is eaſily removed, and raiſes a very great weight with a very moderate force.

The Effect of *Polyſpaſta* is founded upon the following Theorem.

3. If a power apply'd in B, ſuſtain (by means of a *polyſpaſton)* a weight F, ſo that all the ropes AB, HI, GE, EL, CD drawn by the weight F, are parallel to each other: The power will be to the weight, as unity to the number of ropes HI, GF, FL, CD, drawn by the weight B, and therefore as unity is to the number of pulleys higher and lower taken together. See *Plate* 2. Fig. 4.

Hence the number of pulleys and the power being given, it is eaſy to find the weight that will be ſuſtained thereby: or the number of pulleys and weight to be ſuſtained being given, the power is found; or the weight and power being given, the number of pulleys the *polyſpaſton* is to conſiſt of is found.

4. If a power move a weight by means of ſeveral pulleys, the ſpace paſſed over by the power, will be to the ſpace paſſed over by the weight, as the weight is to the power.

Hence, the ſmaller the force that ſuſtains the weight, (by means of the pulley) is, the ſlower is the weight raiſed, ſo that what is ſav'd in force, is ſpent in time. Others define

A Pulley to be a wheel of wood, braſs, iron, &c. that is moveable about a ſmall pin or axis, call'd a center-pin, to which in theory we allow no thickneſs, and therefore is conſidered as a line only.

This pin with the wheel is fix'd in a box of iron or wood, &c. wherein it is work'd by means of a rope plac'd in the grove of its circumference, as in the figure 5. There

There are ſeveral kinds of Pulleys; as the ſingle pulley, (call'd by workmen a *Snatch-Block)* and the double triple, *&c.* pulley, call'd a pair of blocks, *&c.*

In order to conceive how heavy weights may be raiſed by the power of the pulley, obſerve firſt to equipoiſe the weight by the ſingle pulley BAC.

If the Diameter of the pulley BC, be conſidered as a *lever* of the firſt kind, wherein A is the *Fulcrum*, it is evident that B and C, the extreams of the diameter BC, are at equal diſtances from the *fulcrum* A, wherefore to equipoiſe the body there muſt be a weight at E equal to D.

For, as AC the diſtance of the power,

Is to BA, the diſtance of the weight;

So is the weight D, to the power E, or *e contra.*

So is the power E, to the weight D.

Hence 'tis plain, that an upper pulley as B A C is a lever of the firſt kind (ſee LEVER) and its *fulcrum* is at equal diſtances from the points of diſtance of the power apply'd and weight to be raiſed, therefore the power apply'd cannot equipoiſe any greater weight than one which is equal to itſelf.

See *Plate Fig.* 4.

So that it may ſeem, that a pulley is of no more uſe, than that by its turning motion it preſerves the rope from fretting, and from a very great friction, which would require an additional ſtrength, when drawn over an immoveable body, as a beam, *&c.* that would not turn as a pulley does.

But in anſwer to this, it is indeed ſo in upper Pulleys, but in them only: for tis otherwiſe in under Pulleys, as the Pulley NKL. Fig. 5.

The difference lies in this; as you may obſerve, the weight M hangs in the middle at R, and the Rope FN is always lifting at N, and as the other Rope LR, is fix'd at R, therefore conſidering the Diameter of the Pulley NLK as a *Lever* of the ſecond kind, the point N, will be the Point where the Power is apply'd, and the Point L will be the *Fulcrum.* Then I ſay,

As KL, the diſtance of the weight from the *Fulcrum.*

Is to NL, the diſtance of the power from the *Fulcrum*;

So is the power apply'd at N, to the weight that it will equipoiſe at K.

Hence it is plain, that as the diſtance of the power, is equal to twice the diſtance of the weight, therefore the power apply'd will equipoiſe double its weight; wherefore it is always to be underſtood, that by every ſuch Pulley the Force is doubled. See *Plate* Fig. 5.

Now from theſe two Examples, ariſes the following THEOREM.

When a Power (as X) ſuſtains, or draws a weight, by means of ſeveral Pullies, (as BC, IOK, LM; EOF,) each Pulley under which the Rope goes, as EOF, or LM, is equivalent to a *Lever* of the ſecond kind,

kind, as before prov'd, and therefore needs no Demonstration.

It is evident, that every lower *Pulley* is a Lever of the second kind; and as the weight is always in the middle between the power and *Fulcrum*, 'tis very easy to judge or determine, what number of under-Pullies are necessary to equipoise any weight with a given Power.

As for *Example.*

Suppose a Body of 500 Pounds weight, is to be equipois'd by a Power of 25 Pounds weight; how many under Pullies are required for that Purpose?

This Question is easily answered; for as the Power is equal to double the weight, therefore 25 Pound apply'd to one Pulley, will equipoise 50 Pound.

Now if 500, the weight given, be divided by 50, the equipoise of one under Pulley, the Quotient will be 10, the number of under Pulleys required.

But this is worthy Notice; That as much as the Power gains, in Force by means of many under Pullies, so much it loses in Space and Time. See *Plate*, Fig. 6.

Suppose a Power apply'd at A, which draws the Rope downwards to R, to draw up or raise the four Weights B C D E, of the Box F Q, on which they are fix'd.

I say, that in this and all such Cases, the Power A must descend, or run through a great Space, while the Weights rise through a small Space; that is, the Power A must move eight Feet to raise the Bodies B C D E one foot, because eight Parts of the Rope are apply'd to the lower Pullies; therefore it is to be observed in the use of Pullies as in the use of Levers.

That the Space which the weight runs through,

Is to the Space which the Power runs through;

As the Power,

Is to the Weight.

Or, As the Number one,

Is to twice the Number of lower Pullies, *viz.* 8;

So is the Power apply'd, to the weight that it will equipoise.

Thus it appears, that the more Velocity the Power has, the greater is its Force proportionably.

PUMP [in *Hydraulicks*] is a Machine formed of a Syringe for raising of Water.

Pumps are distinguished into several Kinds, with respect to the several manners of their acting. As,

1. The *Common Pump*, sometimes called the *Sucking Pump*, which acts by the Pressure of the Air, and whereby Water is rais'd out of lower into a higher Place not exceeding 32 Foot.

The *Forcing Pump*, which acts by mere Impulse and Protrusion, and raises Water to any Height at Pleasure; and also another.

Called *Ctesebes's Pump*, which was the first and is the finest of them all, which acts both by Suction and Expulsion.

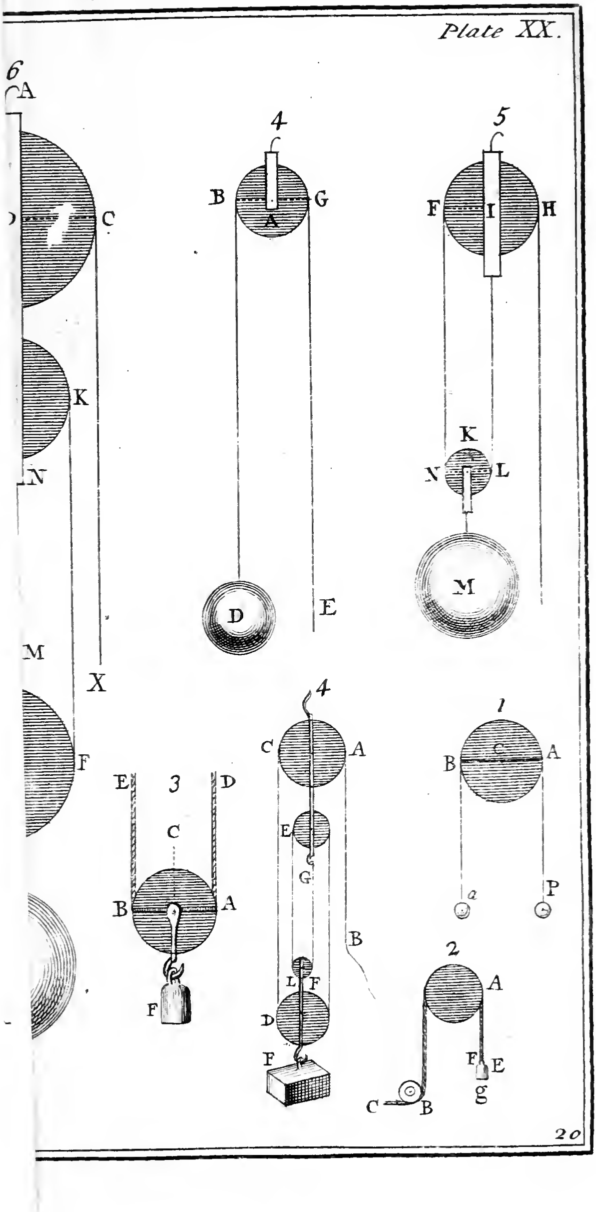


Plate XX.
6
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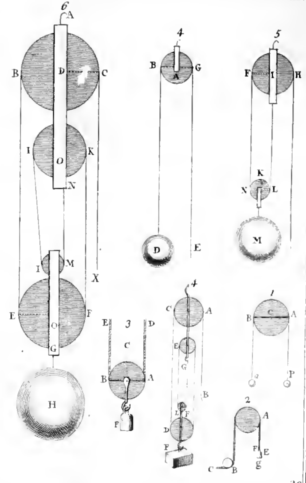
6
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B

PUNCHEON is a common Name for all the Iron Instruments used by Stone-Cutters, Sculptors, Locksmiths, &c. for cutting or piercing their several Matters.

PUNCHION } [in *Carpen-*
PUNCHIN } *try*] A piece of Timber placed upright between two Posts, whose bearing is too great, serving together with them to sustain some great Weight.

The PUNCHEON is usually lower and slighter than the Posts, and is join'd by a Brace or the like of Iron.

Puncheon is also a piece of Timber raised upright, under the Ridge of a Building, wherein the little Forces, &c. are jointed. *Vitruvius* calls the Puncheon *Columen*. *Puncheon* is also used for the Arbour or principal Part of a Machine, on which it turns vertically as that of a Crane, &c.

PURLINS [in *Building*] those pieces of Timber that lie a-cross the Rafters on the inside, to keep them from sinking in the middle of their Length.

By the Act of Parliament for the rebuilding of *London*, it is provided, that all Purlins from 15 Foot 6 Inches to 18 Feet 6 Inches long, ought to be in their Square 9 Inches and 8 Inches: And all in length from 18 Foot 6 Inches to 21 Foot 6 Inches, ought to be in their Square 12 Inches and 9 Inches.

PURBECK-STONE is a hard, greyish Stone, almost like *Sussex-Petties*, they are used for Pavements.

As *to the Price*, it is commonly sold in Slabs (ready polish'd for Chimney-foot Paces) for 2 *s. per* Foot. And Purbeck paving of promiscuous Sizes, only hew'd and squar'd is sold for about 7 *d. per* Foot; also Mitchels are valued at about 1 *s.* 10 *d. per* Foot.

PUTLOGS [in *Carpentry*] are short pieces of Timber (about 7 Foot long) used by Masons in building Scaffolds to work upon. The Putlogs are those pieces that lie at right Angles to the Wall, or horizontal to the Building, with one of their Ends resting on the Ledgers of the Poles, which are those pieces that lie parallel to the side of the Wall of the Building.

PYCNOSTYLE } [In an-
PYCHNOSTYLE } cient *Architecture*] is a Building where the Columns stand very close one to another; one Diameter and a half of the Column being allow'd for the Intercolumniations.

The *Pycnostyle*, is the smallest of all the Intercolumniations mentioned by *Vitruvius*.

Some make the *Pycnostyle* the same with the *Systyle*; others distinguish the latter by its allowing half a Module more in the *Corinthian* intercolumniations.

Mr. *Evelyn* observes, that the *Pycnostyle* chiefly belonged to the *Composite* Order; and was used in the most magnificent Buildings, as at present in the *Peristyle* of St. *Peter's* at *Rome*, consisting of near 300 Columns; and such as yet remain of the Ancients, among

the late discovered Ruins of *Palmira*.

PYLING the Ground for Foundation.

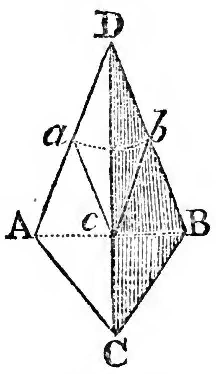
PYRAMID [in *Geometry*] is a Solid standing on a square Basis, and terminating at Top in a point: Or it is a Body whose Base is a *Polygon*, and whose Sides are plane Triangles; the several Tops meeting together in one point.

The Properties of a Pyramid are,

1. All *Pyramids* and Cones standing on the same Base, and having the same Altitude, are demonstrated to be equal.

2. A Triangular *Pyramid* is the third part of a Prism standing on the same Base, and of the same Altitude.

3. Hence, since every Multangular may be divided into Triangulars. Every Pyramid is the third Part of a Prism standing on the same Base, and of the same Altitude.



4. If a *Pyramid* be cut by a Plane *abc*, parallel to its Base ABC, the former Plane or Base will be similar to the latter.

5. All Pyramids, Prisms, Cylinders, &c. are in a Ratio compounded of their Bases and Altitudes, the Bases therefore being equal, they are in Proportion to their Altitudes; and the Altitudes being equal in Proportion to their Bases.

6. *Pyramids*, Prisms, Cylinders, Cones, and other similar Bodies are in a triplicate Ratio of their homologous Sides.

7. Equal *Pyramids*, &c. reciprocate their Bases and Altitudes, *i. e.* the Altitude of the one, is to that of the other; as the Base of the one, to that of the other.

A *Sphere* is equal to a *Pyramid*, whose Base is equal to the Surface, and its Height to the Radius of the Sphere.

8. A *Pyramid* is one third of the perpendicular Altitude multiply'd by the Base.

To measure the Surface and Solidity of a Pyramid.

Find the Solidity of a Prism that has the same Base with the given Pyramid, and divide this by 3; the Quotient will be the Solidity of the Pyramid.

Suppose *v. gr.* the Solidity of the Prism be found 67010328 the Solidity of the Pyramid will be thus found 22336776.

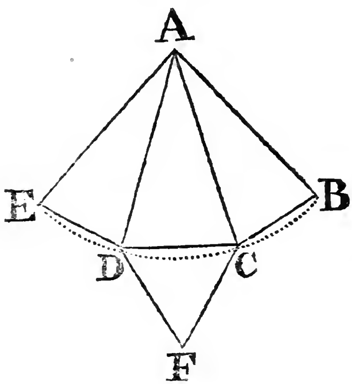
The Surface of a Pyramid is had by finding the Areas both of the Base ABC and of the lateral Triangles ACD, CBD and BDA, the Sum of these is the Area of the Pyramid.

The external Surface of a right Pyramid standing on a regular Polygon Base, is equal to the Altitude of one of the Triangles

angles which compose it, multiplied by the whole Circumference of the Base of the Pyramid.

To describe a Pyramid, on a Plane.

First draw the Base *v. gr.* the Triangle ABC (if the Pyramid required, be Triangular) so as that the Side AB suppos'd to be turned behind, be not express'd. 2. On AC and CB, construct the Triangles ADC, and CDB, meeting in any assumed or determined Point, *v. gr.* D, and draw AD, CD, BD, then will ADBC be a Triangular Pyramid.



To Construct a Pyramid of Paste-Board, &c.

Suppose, *v. gr.* a Triangular Pyramid required.

1. With the Radius AB, describe an Arch BE, as in the Figure, and thereto apply three equal Chords BC, CD and DF.

2. On DC construct an equilateral Triangle DFC, and draw the Right-lines AD and AC, this Paste-board, *&c.* being cut off by the Contour of the Figure, what remains within will turn up into a Pyramid.

To find the Solid Content of a Pyramid.

The RULE.

Multiply the Area of the Base by a third part of the Altitude, and the Product will be the Solid Content of the Pyramid.

Let ABD be a square Pyramid, each Side of the Base being 18.5 Inches, and the perpendicular Height CD is 15 Feet: Multiply 18.5 by 18.5, and the Product is 340.25 the Area of the Base in Inches, which multiply'd by 5, a third Part of an Inch, and the Product of that will be 1711.25, this being divided by 144, the Quotient will be 11.88 Feet.

```
   18.5
   18.5
  -----
    925
  1480
  185
  ------
 342.25 Area of Base.
      5
 ------
144)1711.25(11.88 Content.
```

By Scale and Compasses.

Extend the Compasses from 12 to 18.5 Inches, that Extent turn'd twice over from 5 Feet (a third Part of the Height) will fall at least upon 11.88 Feet, the solid Content. *Pl.* 2. *Fig.* 1.

To find the Superficial Content.

Multiply the slanting Height

```
      180.24
          37
      ------
     126168
     54072
     -------
144)6668.88(46.31
     576       2.38
     ---       ----
      908      48.69
      864
      ---
       448
       432
       ---
        168
        144
        ---
         24
```


F.	I.	P.
1 :	6 :	6
1 :	6 :	6
1 :	6 :	6
	9 :	3
		9.3
2 :	4 :	6.3
		5
11 :	10 :	7.3

(or Perpendicular of one of the Triangles) by half the Periphery of the Base 37, and the Product will be 6668.88, which being divided by 144, the Quotient will be 46.31 Feet: the Superficial Content of all but the Base; then to that add 2.38 Feet the Base, and it makes 48.69 Feet, the whole Superficial Content.

```
144)342.25(2.38
     288
     ---
      542
      432
      ---
      1105
      1152
```

By Scale and Compasses.

Extend the Compasses from 144 to 180.24, and that Extent will reach from 37 to 46.31 feet, the Area of the four Triangles; and extend the Compasses from 144 to 18.5 (one Side of the Base) that Extent will reach from 18.5 to 2.38 *fere*; which added to the other, the Sum is 48.69, the whole Superficies.

Demonstration.

Every Pyramid is a third Part of a Prism, which hath the same Base and Height (by *Euclid* 12.7.)

That is, the Solid Content of the Pyramid ABD, is one third Part of its circumscribing Prism ABEF.

For every Pyramid which has a square Base (such as A*a*B*b* in the Figure) is constituted of an infinite Series of Squares, whose Sides or Roots are continually increasing in Arithmetical Progression, beginning at the Vertex or Point D, its base A*a*B*b* being the greatest Term, and its Perpendicular Height CD is the Number of all the Terms; but the last Term multiplied into the Number of Terms, the Product will be triple the Sum of all the Series; consequently $\frac{NLL}{3} = S$.

And *S* is equal to the Solid Content of the Pyramid.

From hence it will be easy to conceive, that every Pyramid is a third of its circumscribing Prism (that is of a Prism of equal base and Altitude) of what form soever its base is of, *viz.* whether it be Square, Triangular, Pentangular, *&c.*

You may very easily prove a Triangular Pyramid to be a third part of a Prism of equal Base and Altitude, by cutting a Triangular Prism of Cork, and then cut that Prism into three Pyramids; by cutting it diagonally.

A *Triangular* PYRAMID. Let ABC, be a Triangular Pyramid, each Side of the Base being 21.5 Inches, and its perpendicular Height 16 Feet, the Content both Solid and Superficial is desired. *Plate* 2. *Fig.* 2.

First, find the Area of the Base, by multiplying half the Side by the Perpendicular, let fall from the Angle of the Base to the opposite Side; which Perpendicular will be found to be 18.62, the half of which is 9.31, which multiplied by 21.5, the Product will be 200.165 Inches the Area of the Base; then because the Altitude 16 cannot be exactly divided by 3, therefore take a third Part of 200.165, which is 66.72, and multiply it by 16, and the Product will be 1067.52, which divided by 144, the Quotient will be 7.41 Feet, the Solid Content.

9.31 Half Perp.	
21.5 The Side	
4655	
931	
1862	
3)200.165 Area Base	
66.72 a third Part	
16 Height	
40032	
6672	
144)106752(7.41 Solid Content.	
1008	
595	
576	
192	
144	
48	

	F.	I.	P.	
Side	1 :	9 :	6	
Half Perpend.		9 :	4	
	1 :	4 :	1 :	6
			7 :	2
Area Base	1 :	4 :	8 :	8
				4
	5 :	6 :	10 :	8
				4
	3)22 :	3 :	6 :	8
	7 :	5 :	2 :	2

N.B. In casting up this by Feet and Inches, instead of multiplying by 16 the Height, I divide 12 into such 4 Numbers as being multiplied together, the Product may be 16, as 4 and 4, and multiply first by one and then by the other, and a third part of the last Product is the Content.

By Scale and Compasses.

First, find a Geometrical mean Proportional (as before directed) by dividing the Space between 21.5 and 9.31, into two equal Parts, and you will find the middle Part at 14.15, which is the mean Proportional sought.

Then extend the Compasses from 12 to 14,15, and that Extent (turn'd twice over from 16) will fall at last upon 22.23, a third of which is 7.41 Feet, the Content.

To find the Superficial Content.

Multiply the slant Height, (or Perpendicular of one of the Triangles) by half the Periphery of the Base, and to that Product add the Area of the Base, and the Sum will be the whole Superficial Content.

192.1 In-

192.1 Inches the ſlant Height at D.
Half Periph. 32.25 = 21.5 + 10.75

9605
3842
3842
5763

6195.225 Inches the Area of all but the Baſe.
200.165 Area of the Baſe, add

144) 6395.390 (44.41 Feet the whole Content.
576

635
576

593
576

179
144

35

By Scale and Compaſs.

Extend the Compaſſes from 144 to 192:1, that Extent will reach from 32.25 (half the Periphery of the Baſe) to 43.02 Feet, the Content of the upper Part.

And extend the Compaſſes from 144 to half the Perpendicular 9.31, that Extent will reach from the Side 21.5, to 1.39 Feet, the Area of the Baſe, which being added to the other, makes 44.41 Feet, the Content of the Whole.

Let A B C D E F G H be a Pyramid, whoſe Baſe is a *Heptagon*, each Side thereof being 15 Inches, and the Perpendicular of the *Heptagon* is 15.58 Inches, and the Perpendicular Height of the Pyramid H I is 13.5 Feet; the Content Solid and Superficial is requir'd. See *Plate* 2. Fig. 3.

Multiply 15.58 (the Perpendicular) by 52.5. half the Sum of the Sides of the *Heptagon*, and the Product is 817.95, which multiply'd by 4.5. *viz.* $\frac{1}{3}$ of the Height, and the Product will be 3680.775.

Then divide this laſt Product by 144, and the Quotient will be - - - - Feet, the Content.

15.58

```
        15.58  the Heptagon's Perpendicular.
         52.5  the half Sum of the Sides.
       ------
         7790
        3116
       7790
     ----------
     817.950
          4.5  a third Part.
   -----------
    4089750
   3271800
  ------------
144)3680.7750(25.56 Solid Feet.
    288
    ---
     800
     720
     ----
      807
      720
      ---
       877
       864
       ---
        13
       ---
```

By Scale and Compasses.

First, Find a Geometrical mean Proportional between 15.58 and 52.5 (as is before directed) which you will find to be 28.06; then extend the Compasses from 12 to 28.6, and that Extent will reach from 4.5 (twice turn'd over) to 25.56 Feet.

To find the Superficial Content.

Multiply the Height taken from the middle of one of the Sides of the Base 162.75 Inches, by the half Sum of the Sides 52.5 Inches, and the Product will be 8544.375; which divided by 144, the Quotient will be 59.335 Feet, the Content of the upper Part.

```
      162.75
       52.5
     -------
      81375
     32550
    81375
  -----------
144)8544.375(59.335 Feet.
    ----       568 Base add
    1344       ------
     483       65.015 the whole Content.
      517
       855
      ----
       135
```

```
144)817.95(5.68
       979
       1155
      -----
         3
```

By Scale and Compasses.

Extend the Compasses from 144 to 162.74, and that Extent will reach from 52.5 to 59·335 Feet.

And extend the Compasses from 144 to 15.58 the Perpendicular of the *Heptagon*, and the Extent will reach from 5.25 to 5.68 Feet the Content of the Base; which add to the former, and the Sum will be 65.015, the whole Superficial Content.

PYRAMID [in *Architecture*] is a solid massive Edifice which from a Square Triangular, or other Basis, rises diminishing to a Point or Vertex.

Pyramids are sometimes used to preserve the Memory of singular Events; and sometimes to transmit to Posterity the Glory and Magnificence of Princes. But as they are a Symbol of Immortality, they are more commonly us'd as Funeral Monuments.

Such is that of *Cestius* at *Rome*, and those other celebrated ones of *Egypt*, as famous for the enormousness of their Size as their Antiquity.

Those of *Egypt* are all square in their Bases, and it is a thing has been frequently propos'd, to establish a fix'd Measure from them, to be thereby transmitted to Posterity.

The Pyramid is said to have been among the *Egyptians* an Emblem or Symbol of human Life; the Beginning of which is represented by the Base and the End by the Apex, on which account it was they us'd to erect them on Sepulchres.

1. A Pyramid is one third of the perpendicular Altitude multiply'd by the Base.

2. The Superficial Area of a Pyramid is found by adding the Area of all the Triangles, whereof the Sides of the Pyramid consist, in one Sum.

3. The external Surface of a right Pyramid which stands on a regular Polygon Base, is equal

equal to the Altitude of one of the Triangles which compose it, multiply'd by the whole Circumference of the Base of the Pyramid.

A Pyramid should be raised to such a Height as may set it above all the Buildings that accompany it; so that it may be viewed out of the Country, and be a noble Ornament to the City that raised it.

A Pyramid, says M. *le Clerc*, should always be single, or alone, otherwise it looses its proper Signification, which is to represent the Glory of the Prince.

PYRAMIDAL *Numbers*, are the Sum of polygonal Numbers collected after the same manner as the polygon Numbers themselves are extracted from Arithmetical Progressions; they are distinguished into *first*, *second*, *or third Pyramidals*.

PYRAMIDOID, is what is sometimes called a *Parabolic Spindle*, and is a solid Figure, form'd by the Revolution of a Parabola round its Base or greatest Ordinate.

Q

QUADRA [*in Building*] is any square Border or Frame incompassing a Basso, Relievo, Pannel, Painting, or other Work: It is also us'd (but erroneously) for a Frame or Border of another Form, as round, oval, or the like.

QUADRANGLE [in *Geometry*] a Quadrangular or Quadrilateral Figure, or a Figure which has four Sides and four Angles. To the Class of Quadrangles belong, the *Square*, *Paralellogram*, *Trapezium*, *Rhombus*, and *Rhomboides*.

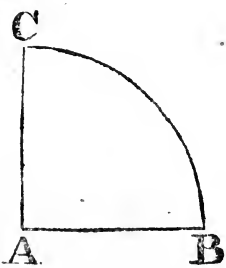
QUADRANT [in *Geometry*] is an Arch of a Circle containing 90 Degrees, or one 4th of the intire Periphery; and is also the Space contained between a quadrantal Arch and two Radii perpendicular one to another, in the Center of a Circle.

QUADRANT is the fourth Part of a Circle.

To find the *Area* this is

The RULE.

Multiply half the arch Line of the Quadrant, (that is, the eighth part of the Circumference of the whole Circle) by the Radius, and the Product is the Area of the Quadrant.



Let *ABC* be a Quadrant or fourth part of a Circle, whose Radius or Semidiameter is 11.3, and the half arch Line 8.875; these multiply'd together, the Product is 100.2875 for the Area.

These are the Rules and Ways commonly given for finding the Area of a Semicircle

Pyramids

Plate XXI.

Fig.3.

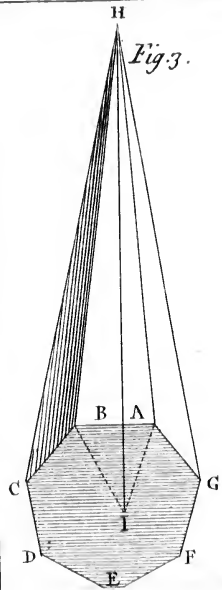


Fig.2.

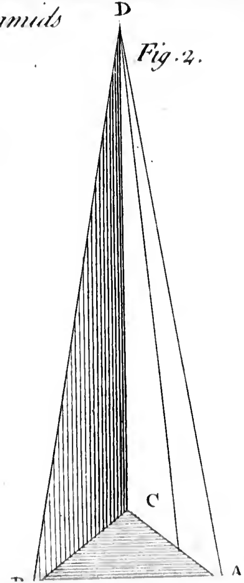
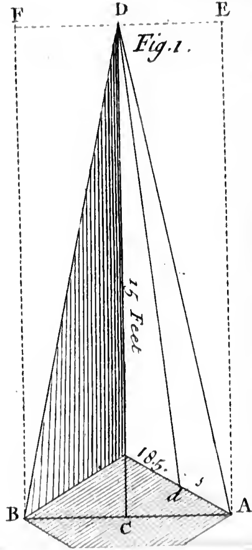
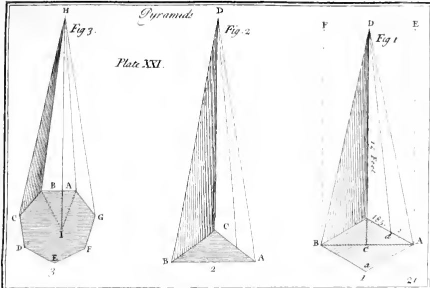


Fig.1.

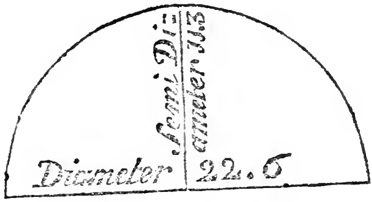



Pyramids
Plate XXI.
Fig 3.
H
B A
C G
I
D F
E
3
Fig. 2
D
C
B A
2
Fig 1
F D E
15 Feet
18 5
B C d A
a
1
21

and Quadrant; but I think it is as good a way to find the Area of the whole Circle, and then to take half that Area for the Semicircle, and a fourth part for the Quadrant.

To find the Area of a Semicirc, *this is the* RULE.

Multiply the fourth part of the Circumference of the whole Circle, (that is, half the arch Line) by the Semidiameter, and the Product will be the Area.



Let *ABC* be a Semicircle, whose Diameter is 22.6, and the half Circumference or arch Line *ACB* is 35.5, the half of which is 75.5, which multiply by the Semidiameter 11.3, and the Product will be 200.575, the Area of the Circle.

$$\begin{array}{r} 17.75 \\ 11.3 \\ \hline 5325 \\ 1775 \\ 1775 \\ \hline 200.575 \end{array}$$ The Area of the Semicircle.

By Scale and Compasses.

Extend the Compasses from 1 to 11,3, and that Extent will reach from 17.75 to 200.575, the Area.

If only the Diameter of the Semicircle be given, you may say by the Rule of Three, as 1 is to 3927, so is the Square of the Diameter to the Area.

By Scale and Compasses.

Extend the Compasses from 1 to the Diameter 22.5, and that Extent turned twice over from 3927, will reach at last to 200.575.

QUADRAT or *Line of Shadows on a Quadrant*, are only a Line of natural Tangents to the Arches of the Limb, and are plac'd there in order to measure Altitudes readily; for it will always be, as the Radius to the Tangent of the Angle of Altitude, at the Place of Observation (that is, to the parts of the Quadrats or Shadows cut by the

the String) so is the Distance between the Station and the Foot of the Object, to the Height above the Eye.

QUADRANTAL *Triangle*, is a Spherical Triangle, one of whose Sides (at least) is a Quadrant, and one right Angle.

QUADRATRIX [in *Geometry*] is a mechanical Line, by the Means whereof we can find right Lines equal to the Circumference of a Circle or other Curve, and the several Parts thereof.

QUADRATURE [in *Geometry*] is the squaring, or reduction of a Figure to a Square, or the finding a Square equal to a Figure proposed.

Thus the finding of a Square containing just as much Surface or Area, as a Circle, an Ellipsis, a Triangle, or other Figure, is call'd the *Quadrature* of a Circle, an Ellipsis, a Triangle, or the like.

The *Quadrature* of Rectilinear Figures comes under the common Geometry; as amounting to no more than the finding their Area's or Superficies, which are in Effect their Squares.

The *Quadrature of Curves*, that is, the measuring of their Area, or the finding of a rectilinear Space equal to a curvilinear Space, is a Matter of much deeper Speculation, and makes a Part of the higher Geometry.

QUADRATURE *Lines* are two Lines frequently placed on *Gunter*'s Sector.

They are mark'd with the Letter Q, and the Figures 5, 6, 7, 8, 9, 10, of which Q signifies the Side of a Square, and the other Figures the Sides of Polygons of 5, 6, 7, &c. Sides. S there stands for the Semidiameter of a Circle, and 90 for a Line equal to 90 degrees in the Circumference.

QUADREL [in *Building*] a sort of artificial Stone perfectly Square, whence their Name, made of chalky, white, pliable Earth, &c. dried in the Shade for two Years.

These were formerly in great request among the *Italian Architects*.

QUADRIPARTITION a dividing by four.

QUADRUPLE a Sum or Number multiply'd by 4, or taken four times.

QUADRILATERAL *Figures*, are those whose Sides are four Right Lines, and those making four Angles, as *Parallelogram*, *Trapezium*, *rectangle Square*, *Rhomboides or Rhombus*.

QUANTITY signifies whatsoever is capable of any Sort of Estimation or Mensuration, and which being compar'd with another thing of the same Nature, may be said to be greater or less, equal or unequal to it.

The Quantity of Matter in any Body, is its Measure arising from the Joint Consideration of its Magnitude and Density.

2. The Quantity of Motion in any Body, is its Measure arising from the Joint Consideration of the Quantity of Matter in, and Velocity of the Motion in that Body.

QUARRELS *of Glass* }
QUARREYS } [in *Glaziery*]

ziery] a Pane or Piece of Glaſs cut in a Diamond Form.

They are of two Kinds, *viz.* Square and Long, each of which is of different Sizes, expreſs'd by the Number of them which makes a Foot, *viz.* 8ths, 10ths, 12ths, 15ths, 18ths and 20ths; but all the Sizes are cut to the ſame Angles, the Acute Angle being 77 Degrees 19 Min. in the Square Quarrels, and 67 Degrees 21 Minutes in the Long ones.

QUARRY, a Place under Ground, out of which are dug Marble, Free-ſtone, Slate, Lime-Stone, and other Matters proper for Building.

In the digging Quarries of *Free-ſtone*, they firſt open a Hole in the Manner of a Well, 12 or 14 Foot in Diameter, drawing up the rubbiſh with a Windlaſs in large Oſier Baſkets, they heap it up all around, and Place the Wheel, which is to draw up the Stones upon it.

As the Hole grows deeper, and their common Ladder too ſhort, they apply a particular Ladder for their Purpoſe: when they are got through the Earth, and are arrived at the firſt Bank or *Stratum*, they begin to uſe their Wheel and Baſkets, to diſcharge the Stones as faſt as they dig through them.

There are uſually ſeven of theſe different Beds or Strata of Stones found of different Heights and ſerving for different Purpoſes; tho' the Number, as well as the Order in which they follow, is various.

As to the drawing of the Stone, *i. e.* freeing it from the Beds, they find that common Stones, at leaſt thoſe that are of the ſofter Kinds, as they lie, have two Grains, a cleaving Grain, running Parallel with the Horizon, and a breaking Grain, Perpendicular thereto.

After they have uncop'd the Stone, *i. e.* cleared it of the Earth, they obſerve by the Grain where the Stone will cleave, and there they drive in a good Number of wedges, till they have by this Means clear'd it from the Reſt of the Rock.

They then proceed to break it; in Order to which they apply a Ruler to it at both Ends about 10 or 12 Inches apart, according to the Uſes the Stone is intended for, and ſtrike a Line, and by this cut a little Channel with their Stone Ax; and ſet five or ſix wedges, (ſuppoſing the Stone to be three or four Foot) driving them in very carefully, with gentle Blows, and ſtill keeping them equally forward.

When they have broke them in Length (which they are able to half an Inch of any Size) applying a Square to the Streight Side, they Strike a Line and proceed as before to break it in Breadth alſo.

This Method of drawing is found greatly preferable to that where the Stones are broken at Random, one Load of the Stones drawn after this Manner, being found to do the Buſineſs of a Load and a Half of the latter.

But this cleaving Grain being ſeldom found in the harder Stones they uſe great heavy Stone Axes only for breaking up theſe in

in the Quarries, with which they Work down a deep Channel into the Stone, and lay two Bars of Iron a Top into this Channel, and drive their Iron Wedges between these Bars.

Some, in drawing of Stone, especially those of a very hard Kind, make use of Gunpowder, and to a very good Effect.

Their Method is as follows, they make a small Perforation pretty deep into the Body of the Rock, so as to have that thickness of Rock proper to be blown up at once; at the further End of the perforation they lay a proper Quantity of Gunpowder, filling up all the Rest with Stones and Rubbish strongly ramn'd in, except a little Space for the Train.

By this Means is the Rock blown up into several Pieces, most of them not too unwieldy for the Workmen to manage.

QUARTER *Round* [in *Architecture*] signifies any Moulding in general, whose contour is either a perfect Quadrant or Quarter of a Circle, or that approaches near to that Figure. Architects commonly call it *Ovolo*, and *Vitruvius Echinus*.

QUARTERS [in *Architecture*] are those slight upright Pieces of Timber placed between the Punchions and Posts, used to lath upon.

They are of two Sorts, *single* and *double*; the *single* Quarters are sawn Stuff two Inches thick and four Inches broad; the *double* Quarters are sawn to four Inches Square.

'Tis a Rule in Carpentry, that no Quarters be placed at greater Distance then fourteen Inches.

QUARTERING [in *Carpentry*] signifies the putting in of Quarters. Sometimes it is used for the Quarters themselves.

QUINDECAGON, is a plain Figure of fifteen Sides and Angles, which, if they are all equal to one another, is call'd a *regular Quindecagon*.

Euclid shows how to describe it in a Circle. *Prop.* 16. *c.* 4.

The Side of a *regular Quindecagon* so described is equal in Power to the half Difference, between the Side of equilateral Triangle, and the Side of the *Pentagon*; and also to the Difference of the Perpendiculars let Fall on both Sides taken together.

QUINQUEANGLED [in *Geometry*] is said of a Figure consisting of five Angles.

QUINTUPLE five Fold or five Times as much as another Thing.

QUIRK [with *Builders*] a Piece of Ground taken out of any Ground Plot or Floor------ Thus if the Ground Plot were Square or Oblong, and a Piece be taken out of a Corner to make a Court or Yard, &c. the Piece is call'd a Quirk.

QUOINS [in *Architecture*] are set in the Corners of Brick, or Stone Walls.

The Word is particularly used for Stones in the Corners of Brick Buildings.

Rustick-Quoins, are those which stand out beyond the

Brick Work, (their Edges being chamfer'd off.)

These latter at two Foot one Face, and one Foot the other, are valued from 1 *s.* to 1 *s.* 4 *d. per* Quoin, Stone and Workmanship.

QUOTIENT [in *Arithmetick*] is that Number in a Division, which arises by dividing the Dividend by the Divisor; and is call'd the *Quotient*, because it answers to the Question, how often one Number is contain'd in another.

R

RABBETING [in *Carpentry*] is the planing or cutting of Channels or Groves in Boards.

RAFTERS [in *Building*] are pieces of Timber, which stand by Pairs upon the Reason, meet in an Angle at the Top, and help to compose the Roof of a Building.

As to their Scantlings, &c. it is provided by an Act of Parliament for Re-building the City of *London*, that the following Scantlings, (which were well consulted by the ablest Workmen before they were reduced to an Act) are set down as fitted for all Edifices great or small, as follows.

As to their Distance, 'tis a Rule in *Architecture*, that no Rafters be laid at greater Distance from each other than 12 Inches.

Principal Rafters in Length.	From		to		Must be in Breadth.		And thick.
	F.	I.	F.	I.	Foot.	Top.	
					Inches	Inches	Inches.
	12	6	14	6			
	14	6	18	6	8	5	6
	18	6	21	6	9	7	7
	21	6	26	4	10	8	8
	24	6	26	4	12	9	8½
					13	9	9

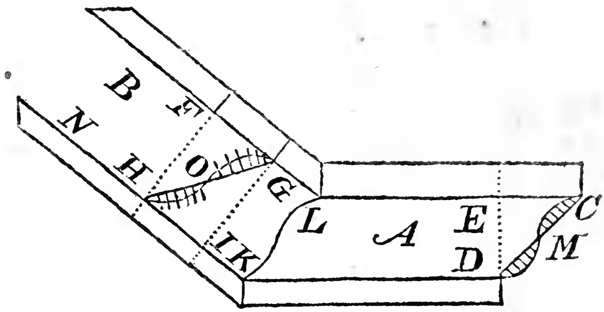
Single Rafters in Length—	6 Foot 6 Inches 8 next 9 next		must
have in their Square ——	4 and 3 4½ and 3¾ 5 and 4	Inches	

Principal RAFTERS, ſhould be near as thick at the Bottom as the Beam, and ſhould diminiſh in their Length one fifth, or one ſixth of their Breadth, the king Poſts ſhould be as thick as the principal Rafters, and their Breadth according to the Bigneſs of them that are intended to be let into them, the middle Part being left ſomething broader than the Thickneſs.

RAG-STONE, ſee *Paving*.

RAKEING. Suppoſe the Level Moulding A join the rakeing Moulding B. How to make their Curves to fit each other at their Mitering L K.

Draw the Moulding or Curve C D, alſo the Right Line C D, which divide into halves in M, and divide the Right Line D M and M C, each into any Number of equal Parts (the more the better.



From thence raiſe Perpendiculars to the Curves, as in the Example; and draw the Line D E Perpendicular to D K.

When you have done this, draw the Line G I and H F Perpendicular to K N, and diſtant from each other, equal to E C, and draw the Line H G, which divide in the middle in O.

Then divide H O into the ſame Number of Parts as D M, and alſo O G as M C, from whence raiſe Perpendiculars at Pleaſure, as in the Example.

When you have ſo done, take the Length of the Perpendiculars between the Right Line and the Curve Line D M, and ſet them on their reſpective Perpendiculars on the Right Line H O; that is, ſet the Line next to D on the Line next H; and ſo on to the Perpendiculars on M C and O G, whoſe Points create the true Curve H O G, by ſticking a Nail into each Point, and bending a thin Lath to touch them all at once, whoſe Edge gives the Curve or moulding requir'd.

N. B. This Method is uſeful in all Pediments or Rakeing Work whatſoever, and will prevent that common Error, which Workmen call tuneing off, after the Work is put together.

RAILS [in *Architecture*] are uſed in different Senſes, as particularly for thoſe Pieces of Timber, &c. which lie horizontally between the *Pannels* of Wainſcot; alſo for thoſe which lie over and under Balliſters in Balconies, Stair-caſes, and the like; and alſo to pieces of Timber, which lie horizontally from Poſt to Poſt in Fences, with Pales or without.

Mr. *Wing* ſays, that the Price of making Rails and Balluſters on Balconies, or about the Platform of great Houſes are worth (for Workmanſhip only) 4*s.* *per* Yard, running Meaſure.

RAISER [in *Building*] a Board ſet on Edge, under the foreſide of a Step, Stair, &c.

RAISING *Pieces* [in *Architecture*] are Pieces that lie under the Beams, on Brick or Timber by the Side of the Houſe.

RANGE [in *Building*] the Side of any Work that runs ſtrait, without breaking out into Angles, is ſaid to range or run range: Thus the Rails and Pannels of one Side of wainſcotting is ſaid to run range.

RATIO or REASON [in *Arithmetick* and *Geometry*] is that Relation of homogeneous Things which determines the Quantity of one from the Quantity of another, without the Intervention of any third: Or it is when two Quantities are compar'd one with another, with Reſpect to their greatneſs or ſmallneſs, that Compariſon is called *Ratio.*

RATIONAL *Quantity* or *Number*, is a Quantity or Number commenſurable to Unity.

As, ſuppoſing any Quantity to be 1, there are infinite other Quantities, ſome of which are commenſurable to it, either ſimply or in Power, and theſe are called by *Euclid Rational Quantities*; and the reſt that are incommenſurable to 1, he calls *Irrational Quantities.*

RATIONAL *Integer*, or *Whole Number*, is that of which Unity is an Aliquot Part.

RATIONAL *Fraction* or *Broken Number*, is that which is equal to ſome Part or Parts.

RATIONAL *Mix'd Number*, is that which conſiſts of a Mix'd Number and a Fraction.

RAY [in *Opticks*] a Line of Light propagated from a Radiant, through an unreſiſting Medium.

Common RAY [in *Opticks*] is ſometimes us'd for a Right-line drawn from the Point of the concourſe of the two optical Axes, through the middle of the Right-line, which paſſes by the Center of the Pupil of the Eye.

PRINCIPAL RAY [in *Perſpective*] is the perpendicular Diſtance between the Eye and the vertical Plane or Table, as ſome call it.

RECIPROCAL *Figures* [*in Geometry*] are ſuch as have the Antecedents and Conſequents of the Ratio in both Figures.

RECIPROCAL *Proportion* is when in four Numbers, the fourth is leſſer than the ſecond, by ſo much as the third is greater than the firſt; and *vice verſa.*

RECTANGLE [in *Arithmetick*] is the fame with Product, which fee.

RECTANGLED, as a *Rectangled Triangle*, is a Triangle one of whofe Angles is Right or equal to 90 Degrees.

There can be but one Right-angle in a Plain Triangle; therefore a rectangled Triangle cannot be equilateral.

RECTANGULAR [in *Geometry*] is applied to Figures and Solids, which have one or more Angles right.

RECTILINEAR [in *Geometry*] i. e. *Right lined*, is applied to Figures, whofe Perimeter confifts of Right-lines.

REDUCT [in *Building*] a Querk or little Place taken out of a larger, to make it more uniform and regular: or for fome Conveniencies, as for little Cabinets on the Sides of Chimneys, Alcoves, &c.

REDUCTION [in *Arithmetick*] is the converting Monies, Weights and Meafures, into the fame Value in other Denominations, *ex. gr.* Pounds into Shillings and Pence, &c.

REFLECTION in general, is the Regrefs or Return, that happens to a moving Body, becaufe of the meeting of another Body, which it cannot penetrate; thus the material Rays are reflected varioufly from fuch Bodies as they cannot pafs through.

REFLEX } [in *Painting*] is un-
REFLECT } derftood of thofe Places in a Picture, which are fuppofed to be illuminated by a Light, reflected by fome other Body reprefented in the fame Piece.

REFLEX *Vifion* } [in
REFLECTED *Vifion* } *Catoptricks*] is that which is performed by means of Rays reflected from polifh'd Surfaces of Objects to the Eye.

REFRACTION [in *Mechanicks*] in General, is the Incurvation or change of Determination in the Body moved, which happens to it while it enters or penetrate any Medium.

REFRACTION [in *Dioptricks*] is the Variation of a Ray of Light, from that Right-line which it would have paffed in, had not the Denfity of the Medium turn'd it afide.

REFRACTION *from the Perpendicular*, is when a Ray falling inclin'd, from a thicker Medium into a thinner, in breaking departs from that Perpendicular.

REFRACTION *to the Perpendicular*, is when it falls from a thinner into a thicker, and fo becomes nearer the Perpendicular.

REGULA [in *Architecture*] See *Orlo*.

REGULAR BODIES are Solids, whofe Surface is compos'd of regular and equal Figures; whofe Solid Angles are all equal, fuch as the *Tetrahedron*, *Hexahedron*, *Octahedron*, *Dodecahedron*, and *Icofahedron*.

There can be no more regular Bodies befides thefe.

REGULAR *Figures* [in *Geometry*] are fuch whofe Sides, and confequently their Angles, are all equal to one another: Whence all regular Multilateral Planes

Planes are called *Regular Polygons.*

The Area of ſuch Figures is ſpeedily found, by multiplying a Perpendicular let fall from the Center of the inſcrib'd Circle to any Side, by half that Side; and then that Product by the Number of the Sides of the Polygon.

RELIEVO } [in *Sculpture*]
RELIEF } is applied to a Figure which projects or ſtands out, prominent from the Ground or Plane whereon it is form'd; whether that Figure be cut with a Chiſſel, moulded or caſt.

The *Alto Relievo* } is when
High RELIEF } the Figure is form'd according to Nature, and projects as much as the Life.

Baſſo RELIEVO }
Baſs or low RELIEF } is when the Work is rais'd but a little from its Ground, as in Medals, Frontiſpieces, Feſtoons, Foliages, and other Ornaments of Friezes.

Demi RELIEVO, is when one half of the figure riſes from the Plan, *i. e.* when the Body of the figure ſeems cut in two, and the one half of it is clapp'd upon a Ground, when there are ſome Parts that ſtand clear out, detach'd from the reſt in a *Baſſo Relievo*, then the Work is called *Demi-Baſs.*

RELIEVO [in *Architecture*] is the Projecture of any Ornament.

Daviler obſerves, that this ought always to be proportion'd to the Magnitude of the Building it adorns, and the Diſtance at which 'tis to be viewed.

RELIEVO [in *Painting*] is a Degree of Force or Boldneſs wherewith the Figures ſeem at a due Diſtance, to ſtand out from the Ground of the Painting, as if they were really imboſs'd.

RENDERING [in *Building*] See *Pargeting.*

REPOSITORY, a Storehouſe, or Place where things are laid up and kept. *Architects* more particularly uſe it to ſignify ſuch a Place as is built for the laying up Rarities, either in Painting or any other Art.

RESERVATORY, a Place to which Waters are brought together, not only to make *Jets d'eaux* one of the greateſt Ornaments of a Garden; but alſo for ſupplying a noble Seat with Water for Family Uſes. See *Reſervoir.*

If a Perſon ſhall be ſo happy as to find out Water in a Place for which he may conveniently make a Reſervatory, without the Help of Machines, much Expence will be ſav'd thereby: But if that be impoſſible to be done, of Neceſſity Recourſe muſt be had to *Hydraulick* Machines, in order to raiſe it from the Bottom of Pools into *Reſervatories*, that it may be afterwards let down into Gardens, Houſes, *&c.*

Theſe Machines are now much in Uſe, and many People prefer them before natural Water-Courſes, by Reaſon of the Quantity of Water they furniſh, and the nearneſs of the *Reſervatories*, and Conduits or Pipes.

Water is rais'd by different Machines; first, by Pumps and Horses; and Secondly the two Elements of Air and Water are us'd to turn Mills, and these are infinitely to be preferr'd; these Machines almost always furnishing us with Water, as may be said, Night and Day.

Those *Reservatories* that are made on the Ground are usually Parcels of Water or moist Channels, from whence the Waters are brought together in great Quantities; these are made deep, that they may contain the more, and not be so soon empty.

If these can be made near an House, it will be much better; but if there be a Necessity that the Reservatory be in the Fields, it must be surrounded with a Wall.

Those *Reservatories* that are rais'd above Ground, cannot be expected to be made as large as the others, nor of Consequence be capable of holding as much Water; the Difficulty to support them, and Charge of the Lead, wherewith to line them, not admitting of it; they are to be rais'd upon Arches or Stone Pillars, with Timber Work thereon to form the Bottom and Sides, which must be lin'd with strong Sheets of Lead, well soldered together. The Timber Work ought to be very solid and strong, that it may bear the great Weight of the Water.

The Ancients had 3 Ways for the Conveyance of Water, *viz.* Subterranean Aqueducts, Leaden Pipes, and Stone or Earthen Pipes; which are still in Use, and to which we may add those of Wood, Brass and Copper.

Subterranean Aqueducts ought to be built of Free-Stone, and cover'd over with Arches or flat Stones, to the End that the Sun may not have an Influence upon the Water: If a Rock happens to be in the Way, it must be cut thorough, and if a Mountain obstructs the Passage, a Way must be made through it, and the Aqueduct must be carried on through them, and Props us'd of 50 Fathom long from Place to Place, in Order to give the Water a little Air; and as to the Bottoms and Vallies which interrupt the Level of the Conveyance, they are to be fill'd up with Rubbish and Heaps of Masonry, or with Arches and the like.

The Water runs into these Aqueducts after different Ways, either through Stone or Leaden Pipes, Free-Stone, Troughs, Trenches made of Lime and Cement or Clay.

There are sometimes Veins of Gravel or Gravel Stones naturally met with, through which the Water will run without any loss: Room ought always to be made or allow'd for two small Paths on each Side of these Troughs or Conveyances, that there may be a Passage along by them, if there be Occasion; and besides, there must an imperceptible Declivity be given to these Troughs, that the Water may the more easily run along.

These

These Sorts of Aqueducts are proper to collect Spring Water, and to convey it into a *Reservatory*; for the Waters being not clos'd up therein, as in Pipes, they lose the Declivity and the Force which they ought to have to mount up into the Air.

Leaden Pipes are the most commodious for raising of Water; you may make them rise, fall and turn, without hurting the running of the Water thro' them: There are two Sorts of them, *viz.* cast and soldered Pipes.

The first are cast in Moulds; of what Length you please, and are generally 12 Foot long; they are made thicker than the solder'd ones, for Fear of Blows; and therefore are better and more valued; but they cost more by reason of their Weight.

Soldered Pipes are only Sheets of Lead, bended and soldered together at the Junctures, the biggest Leaden Pipes not exceeding six Inches Diameter; these are thrust into one another and soldered: These are apt to burst and to waste, laid in Earths that are full of Chalk.

Stone or *Earthen* Pipes was a third Way the Ancients had for the Conveyance of Water, and are those that cost the least and yet will keep the best.

These Pipes are a Composition of baked Earth, like that of which they make earthen and Stone Pots; they join the Bodies of them, which are two or three Feet long to one another; and make Use of Mastick with some Hemp or Flax for the Junctures.

When these Pipes are made Use of for the Conveyance of forc'd Waters, they encompass them with a Lay of Cement, five or six Inches thick, which will preserve them a long time, provided they have the Precaution; first, to let the Conduit dry for several Months, before the Water is turn'd into it; that so the Cement may have Time to harden: And secondly, to secure these Pipes which are very brittle, with some Brick Work, so that they may not sink down too much.

These Pipes are more proper for the Conveyance of the Discharges of Basons, than spouting Water, which they cannot long be able to bear; they are subject to Fox-Tails, which are very small Roots, which passing through the Pores of the Earth or Stone, or through the Mastick which rots in the Ground, are fed by the Water and become so thick and long, that they intirely stop the Pipe.

There are some who pretend that the Fox-Tail comes from the Hemp that is us'd with the Mastick for the Junctures, or else from some Seeds, which with the Water got into the Pipe.

Stone or Earthen Pipes are particularly valued, for the Conveyance of Spring Water to drink; for being glaz'd on the inside, the mud will not stick to them, and the Water is better preserv'd and clearer than in other Pipes; besides that it does not acquire that ill

Quality in paſſing through them, as it does through Lead or Iron.

For making wooden Pipes, they take large Trees of Oak, Elm or Alder, and the ſtraiteſt that can be got; they bore them thorough and make a Channel of three or four Inches Diameter: they frame them after ſuch Manner, that the End of the one may be thruſt into the other, and bind them with an Iron Hook or Circle, and cover the Junctures with Pitch.

Theſe Sort of Pipes are good in Marſhy Grounds, and ſuch as are naturally moiſt; for they ſoon periſh in thoſe that are dry.

The Water that paſſes thro' them, M. *Chomel* ſays, is of a dark red Colour, and has always a particular Taſte.

Iron Pipes are caſt in Moulds, and are now much us'd; they have the ſame good Qualities as thoſe of Lead; they will laſt long, and coſt four or five times leſs Money.

Some of them are made to 18 Inches Diameter; each Pipe is three Foot and a half long, and there are Bridles at each End of them, which are join'd and clos'd together by Screws and Worms, between which they put Roundels of Leather and Maſtick.

As to the Proportion and Bigneſs of the Conduits and Pipes, in Reference to the *Jet d'Eau* or throwing of Water. it is upon that the Beauty of Spouting Water depends; for if the Pipes are too ſmall, or that they furniſh the Baſons with too much Water, without a juſt Proportion, they will form ſmall, weak and ill fed Caſts; beſides theſe Pipes are ſubject to be eaſily choak'd up and to burſt.

Now to play a *Jet d'Eau* of four or five Lines, that is one whoſe Ajutage is four or five Lines Diameter, which forms a Paſſage of an Inch and the ſeventh Part of an Inch in Circumference, you muſt have a Pipe of an Inch and a half Diameter: For a *Jet d'Eau* of ſix or ſeven Lines, you muſt have a Pipe of 2 Inches; for one of eight or nine Lines, a Pipe of three Inches; and for a large *Jet d'Eau* of an Inch, a Pipe of four Inches Diameter; and for a larger *Jet d'Eau* of 15 or 16 Lines, you muſt have a thick Pipe of ſix Inches Diameter.

It ſhould be held for a general Rule, that the Paſſage or Mouth of the Ajutages, ſhould be four times leſs than the Opening or Diameter of the Pipes of the Conduit; to the End that the Pillar of Water may be proportioned, and that the Swiftneſs in the Pipes may be equal.

Add to this, that there muſt be too great a Friction in the ſmall Conduits with Regard to great Ajutages, and in the Brink or Edge of ſome Ajutages, in reference to large Conduits.

Note, that 12 Lines make an Inch.

There are ſeveral Sorts of Ajutages; but the moſt common

mon are rais'd ones, and ſuch as have but one Mouth or Paſſage; and they are alſo the beſt, and do not ſtop ſo often as the flat ones; which are pierced with ſeveral Holes or Clefts, plac'd oppoſite to one another, or elſe they ſolder on ſeveral other ſmall Ajutages.

It is certain, that the larger the Conduits or Conveyance are, the better the Water paſſes; it is the Soul of good *Jets d'Eau*, which that they may be well fed, ſhould have a Conduit of the ſame Bigneſs, thro'-out from the *Reſervatory* to the *Ajutage*, without Diminution. This will furniſh more Water, and give more Vigour to the *Jet* or Caſt, which without will, as it were, be choak'd up afar off.

Some indeed are of a contrary Opinion, and maintain that in a Conveyance of 100 Fathom long, it ought to be bigger in the firſt 50 next the *Reſervatory*, than in the other 50 reaching to the *Ajutage*; and they pretend that the Diminution of the Bigneſs, ſhould be about an Inch Diameter; to the End, ſay they, that the Water may begin to be forced, and pent at a little Diſtance in the Pipe, and which ſhould always run with ſome Diminution to the very out-let of the Water. But others again ſay, that they have no ſolid Reaſon to ſupport their Fancies.

There is but one Caſe only wherein the Diameter of the Conveyances ought to be diminiſh'd; and that is, when they are ſo long as three or four hundred Fathom; then the Pipes are to differ thrice in Bigneſs, for without it, in the long Courſe the Water is to run, it will, as it were, ſleep, and loſe much of its Strength; but on the Contrary, the different Sizes revive and actuate it.

For Example, A Conduit that is 300 Fathom long, ſhould have the firſt hundred of eight Inches Diameter, the next of ſix, and the laſt of four Inches Diameter.

But in thoſe Conveyances or Pipes of 100 or 150 Fathom, you muſt continue the ſame Diameter throughout the whole Length, even to the Ajutage.

When there are ſeveral *Jets d'Eau*, as ſuppoſe five or ſix to be play'd in a Garden, it is not neceſſary that there ſhould be five or ſix Conveyances or different Pipes made from the *Reſervatory*, it would be a ſuperfluous Charge, and contrary to all good Oeconomy: two or three are enough; but they muſt be of ſuch Proportion and Bigneſs, as to be ſufficient to ſupply all theſe *Jets d'Eau* with Water, in ſuch a Manner that they may play all together equally, and without falling lower than one another.

Now to play three *Jets d'Eau*, each of which is from ſix to ſeven Lines in Diameter, your Pipe muſt be ſix Inches; and for three *Jets d'Eau* of four Lines, the Pipe muſt be four Inches; the Pipe they continue of the ſame Bigneſs till over-againſt the Baſons, or they diminiſh it proportionably by

Bran-

Branches; and thus in a Pipe of six Inches, they make Branches of two Inches Diameter, to the End that the Water may be equally diſtributed for the Out-lets.

It is to be obſerv'd, that the End of the Pipe next the *Reſervatoty*, ought to be two Inches or more in Diameter than the Reſt: for Example, if a Pipe be four Inches in Diameter, the Sucker or Opening muſt be ſix Inches in the Bottom of the *Reſervatory*, to the End that the Entrance being larger, it may ſerve for a Funnel for the Water to enter in more readily, and yield a greater Supply to the *Jets d'Eau*, you muſt make a Regard or Head, that is anſwerable in Bigneſs to the Diameter of the Pipe; and take Care that as much Water paſſes through the oval Hole of the Spout, and what ſome call the Buſhel, as thro' the circular Hole of the Pipe.

RESERVOIR, a Place where Water is collected and reſerv'd to be convey'd occaſionally through Pipes, &c. or to be ſpouted up, &c.

The *Reſervoir* is a Building or large Baſon, uſually of Wood lin'd with Lead, where Water is kept to ſupply the Occaſions of the Houſe.

At *Canons*, the noble Seat of the Duke of *Chandois*, is a very large *Reſervoir*, a Top of the Houſe, to which the Water is rais'd by a very curious Engine, contriv'd for the Purpoſe.

This *Reſervoir* is ſo capacious, as that beſides ſupplying all Parts of the Houſe by Means of Pipes and Cocks, it likewiſe turns a Mill.

A *Reſervoir* is alſo ſometimes a large Baſon of ſtrong Maſonry, glazed or paved at the Bottom: where the Water is reſerv'd to feed *Jets d'Eau* or ſpouting Fountains.

Such is that vaſt one on the Top of *Marli* in *France*, call'd *Trou d'Enfer*, i. e. Hell-Mouth, whoſe Surface, *Daviler* tells us, contains 50 Acres, and its Depth ſuch as under that Superficies to contain 100000 Cubick Fathom of Water.

RESOLUTION [in the *Mathematicks*] is a Method of Invention, whereby the Truth or Falſhood of a Propoſition, or the Impoſſibility is diſcovered, in an Order contrary to that of Syntheſis or Compoſition.

RESSAUT [in *Architecture*] is the Effect of a Body, which either projects or ſinks, *i. e.* ſtands more out or in than another; ſo as to be out of the Line or Level with it.

RETURN [in *Building*] is a Side or Part that falls away from the foreſide of any ſtrait Work.

RIBBING *Nails*, ſee *Nails*

RHOMBOIDES [in *Geometry*] a Quadrilateral figure, whoſe Sides and Angles are unequal, but the oppoſite ones equal; but is neither equilateral nor equiangular. Or,

A RHOMBOIDES is a Figure having four Sides, the oppoſite whereof are equal and parallel; and alſo four Angles, the oppoſite of which are equal,

To find the Superficial Content.
The RULE.

Multitiply one of the longest Sides of it, by the Perpendicular let fall from one of the Obtuse Angles to one of the longest Sides, and the Product will be the Content.

19.5
10.2
390
195
19830

Let *ABC* be a Rhomboides given, whose Sides *AB* or *CD* is 19.5 Feet, and the Perpendicular *AE* is 10.2, which multiply together, the Product is 198.9, that is 198 Superficial Feet, and 9 tenth Parts the Content. See the *Plate*, Fig. 1.

Demonstration.

If *B C* be extended to *F*, making *CF* equal to *D E*, and a Line be drawn from *B* to *F*, so will the Triangle *CB E* be equal to the Triangle *AD E*, and the Parallelogram *AEFB* be equal to the Rhomboides *ABCD*, which was to be proved. *Plate* 1. *Fig.* 1.

To describe the *Rhomboides ABCD*, whose Angle at *G* shall be equal to the given Angle *HG I*, its longest Sides each equal to the given Line *KK*, and its shortest each equal to the Line *L M*.

First, Make *C D* equal to *KK*, and make the Angle *C* equal to the Angle *HG I*, and make *CA* equal *L M*.

Secondly, On *A* with a Radius *CD* describe the Arch *EE*, and on *D* with a Radius *C A*, describe the Arch *FF*, intersecting the Arch in *EE* in *B*.

Thirdly, Join *AB* and *B D*, and the *Rhomboides* is compleated as required. *Plate* 1. *Fig.* 2.

RHOMBUS [in *Geometry*] is an obliquangular Parallelogram, or a quadrilateral Figure whose Sides are equal and parallel, but the Angles unequal, two of the opposite ones being Obtuse, and the other two Acute. Or,

RHOMBUS is a Figure representing a Quarry of Glass, having four equal Sides, the opposites of which are equal, two of its Angles being Obtuse and two Acute.

To find the Superficial Content.
The RULE.

Multiply one of the Sides by a Perpendicular let fall from one of the obtuse Angles to the opposite Side, and the Product is the Content.

Perpend.	13.42
The Side	15.5
	6710
	6710
	1342
Product	208.010

Let *ABCD* be a Rhombus given, whose Sides are each 15.5 Feet, and the Perpendicular *EC* is 13.42, which multiply'd toge-

together, the Product will be 208.010; which is the Superficial Content of the *Rhombus*.

By Scale and Compasses.

Extend the Compasses from 13.42, that Extent will reach from 15,5 the same way to 208 Feet, the Content.

Demonstration:

Eet *CB* be extended out to *F*, making *DF* equal to *GD* and draw the Line *BF*; so shall the Triangle *DBF* be equal to the Angle *ACE*: For *DF* and *CE* are equal, and *BF* is equal to *AE*, because *AB* and *CF* are parallel; therefore the Parallelogram *ABEF* is equal to the Rhombus *ABCD*. See *Plate* 1. *Fig.* 2.

To delineate a Rhombus, *whose Sides shall be equal to a given Line* AB.

Make *DC* equal to *AB*, then on *C* with the Radius *DC*, describe the Arch *DEF*, and make *DE* and *EF* equal to *DC*.

2. Join *DE*, *EF*, and *FC* and the Rhombus is compleated as requir'd.

Note. That as the Angles of this Figure are all oblique, *viz.* the Angles *LH* acute, and *KI* obtuse, therefore their Diagonals *LH* and *KI* are unequal, *viz.* *LH* is longer than *KI*, notwithstanding that the Sides are all equal as in the Geometrical Square. Therefore if a Geometrical Square hath any two of its opposite Sides put out of a perpendicular Position, so as to alter their Right Angles, it instantly becomes a Rhombus or Diamond Form.

RIDES, Hinges for Doors.

RIDGE [in *Building*] the highest Part of the Roof or Covering of a House.

RIDGE *Tiles*, See *Tiles*.

RIGATE *Stones*, See *Free-Stones*.

RIGHT [in *Geometry*] Something that lies evenly, and without inclining or bending the one way or the other.

RIGHT *Angle*, is that form'd by two Lines, falling perpendicularly one on another.

RIGHT *Angled*, is understood of a Figure, when its Sides are at Right-angles, or stand perpendicularly one upon another.

ROD, a Measure of Length, containing by Statute sixteen Foot and a half *English*.

ROLLERS } [with *Carpenters*, *Masons*, &c.]
ROLLS }
are plain Cylinders of Wood, seven or eight Inches in Diameter, and three or four Foot in Length, us'd for the removing of Beams, huge Stones, or other like Burthens; which are cumbersome, but not exceeding heavy.

These *Rollers* are plac'd successively under the fore-part of the Massives or heavy Bodies to be remov'd; which at the same Time are push'd forward by Levers *&c.* apply'd behind.

Endless Rollers are us'd when they are to remove Blocks of Marble, or other excessive heavy Loads.

To give these the greater Force, and prevent their Bursting they are made of Wood jointed together by cross Quarters, being about twice the Length of com-

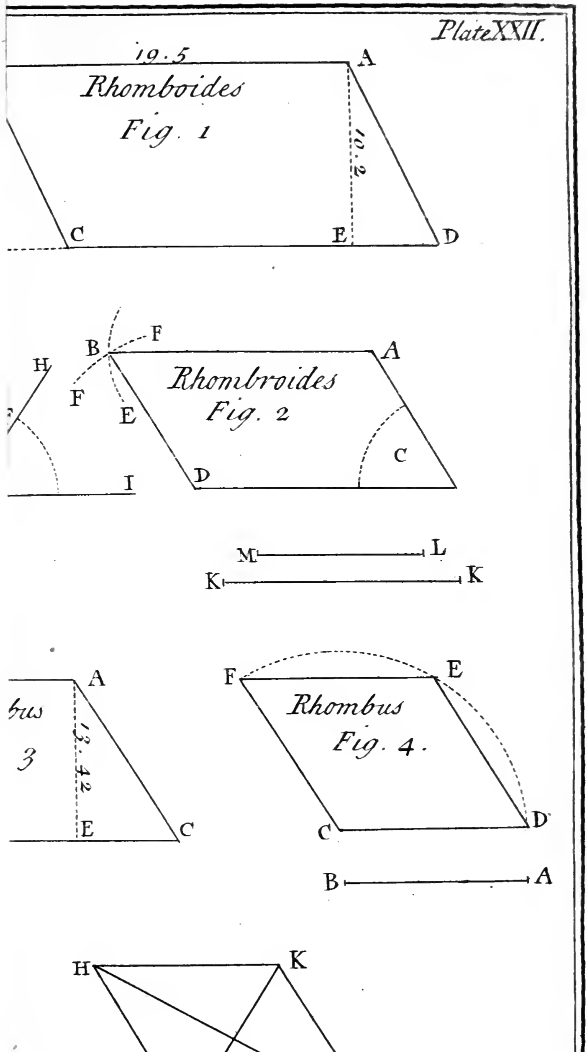
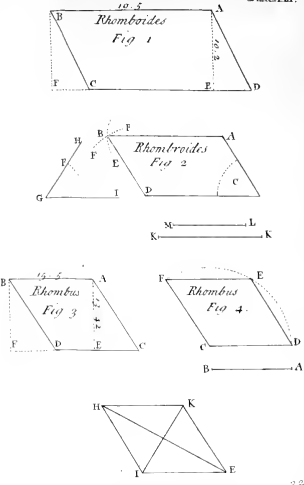


Plate XXII.
19.5
A
Rhomboides
Fig. 1
10.2
C
E
D
B
F
A
H
Rhombroides
Fig. 2
F
E
C
D
I
M
L
K
K
A
bus
3
13.42
E
C
F
E
Rhombus
Fig. 4.
C
D
B
A
H
K
I
E
22


10.5
Rhomboides
Fig 1
10.2
B
A
F
C
E
D
Rhomboides
Fig 2
H
B
F
A
E
F
F
C
G
I
D
M
L
K
K
15.5
B
A
Rhombus
Fig 3
12.4
F
D
E
C
F
E
Rhombus
Fig 4.
C
D
B
A
H
K
I
E

common *Rollers*, and girt with ſeveral large Iron Hoops at each End.

At about a Foot Diſtance from the Ends are four Mortoiſes, or rather but two; but pierced through and through; into which the Ends of long Levers are put, which the Workmen draw by Ropes faſten'd to the End; ſtill changing the Mortoiſe, as the Roller has made the quarter of the Turn.

ROLLING [in *Mechanicks*] *i. e.* Revolving, is a Kind of Circular Motion, wherein the moveable turns round its own Axis or Centre, and continually applies new Parts of its Surface to the Body it moves upon.

The Motion of *Rolling* is oppos'd to that of *Sliding*, in which the ſame Surface is continually apply'd to the Plane it moves along.

The Friction of a Body in *Rolling*, or the Reſiſtance made to it by the Roughneſs of the Plane it moves on, is found to be much leſs than the Friction in ſliding,

Hence is the great Uſe of Wheels, *Rollers*, &c. in Machines as much of the Action as poſſible, being laid thereon to make the Reſiſtance the leſs.

ROMAN *Order* [in *Architecture*] is the ſame with the *Compoſite*. It was invented by the *Romans* in the Time of *Auguſtus*, and ſet above all others, to ſhew that the *Romans* were Lords over other Nations; it is made up of the *Ionic* and *Corinthian* Orders.

ROOF [in *Architecture*] is the uppermoſt Part of a Building.

The Roof contains the Timber Work and its Covering of Slate or Tile, or whatſoever ſerves it as a Cover, tho' Carpenters uſually reſtrain *Roof* to the Timber Work only.

The Form of *Roofs* are various, ſometimes pointed; in which Caſe, the moſt beautiful Proportion is, to have its Profile an equilateral Triangle.

A *Square* ROOF, is that where the Angle of a Roof is a Right Angle, which therefore is a mean Proportional between the *Pointed* and

Flat ROOF, which is in the ſame Proportion as a Triangular Pediment. This is chiefly us'd in *Italy* and the hot Countries where little Snow falls.

Sometimes *Roofs* are made in the Pinnacle Form.

Roofs have ſometimes a *double Ridge*, and ſometimes *mutilated*, *i. e.* they conſiſt of a *true* and a *falſe Roof*, which is laid over the former.

This laſt is particularly called a *Manſard*, from M. *Manſard*, a famous *French* Architect, the Inventor; ſometimes they are in the Form of a *Plat-Form*, as moſt of the Eaſtern Buildings are.

Truncated ROOF is one, which inſtead of terminating in a Ridge or Angle, is cut ſquare off at a certain Height, and cover'd with a Terraſs, and ſometimes encompaſs'd with a Balluſtrade.

Sometimes a *Roof* is made in the Manner of a *Dome*, that is, having its Plan ſquare, and the Contour circular.

Round Roof, is that where the Plan is round or oval, and the Profile a direct Defcent.

Sometimes the Bafe being very large, is cut off to diminifh its Height, and is cover'd with a Terrafs of Lead rais'd a little in the middle, with Sky-Lights from Space to Space, to give Light to fome *Corridore*, or other intermediate Pieces, which without fuch an Expedient would be too dark.

When the Walls have been rais'd to their defign'd Height, the Vaults made, the Joifts laid, the Stairs, *&c.* brought up, then the Roof is to be raifed, which embracing every Part of the Building, and with its Weight equally preffing upon the Walls, is as a Band to all the Work, and befides, defends the Inhabitants from Rain or Snow, the burning heat of the Sun; and the Moifture of the Night, adds no fmall Help to the Building, by cafting off the Rain Water from the Walls, which altho' it feems at prefent to do but little Hurt, yet in the Procefs of Time, is the Caufe of much Damage.

Vitruvius tells us, the firft Men built their Houfes with flat Roofs, but finding that thefe did not defend them from the Weather, they (being conftrain'd by Neceffity) begun to make them ridg'd; that is to fay, rais'd in the middle.

Thefe Roofs are to be rais'd to a higher or lower Pitch, according to the Country in which they are.

For which Reafon in *Germany*, they raife their Roofs to a very great Pitch, by Reafon of the great Quantity of Snow that falls there.

They cover their Roof with *Shingles*, (*i. e.* fmall Pieces of Wood, or with thin Slates or Tiles; for if they would raife them otherwife, they would be ruin'd, by Reafon of the Weight of the Snow.

But we who dwell in a more temperate Climate, ought to chufe fuch a Pitch as may fecure the Building, and be of handfome Form.

Therefore we commonly divide the Breadth of the Roof into four equal Parts, and take three of them for the Roof, which according to fome makes the moft agreeable Pitch for our Country, and is the Foundation for raifing any Manner of Roof, whether Square or Bevel.

As to Roofs, fays a modern Author, there is a Plate to go round a Building, which either may or may not be accounted a Part of the Roof, it may be efteemed as the Foundation or Tye of the Walls, or it may be taken as only that on which the Roof lies.

Thefe Plates are to be Dovetail'd at the Angles, and tenented together at their Length, which is what the Workmen call cogging down to the Plate which prevents its flying out from the Foot of the Angles of a Building; Pieces Dovetail'd crofs the Angles of the Plate, ferve to keep it from fpreading, and is the Foot of the Hip.

There are various Sorts of Roofs,

Roofs, and various Ways of framing them, and different Heights for Buildings of the same Breadth, according to the different Sentiments of Surveyors or Carpenters. And a good Roof is the most difficult and most useful Part of Carpenters Work.

The common Pitch of Roofs is to have the Rafters Length, if it spann'd the Building at once, to be three fourths of the Breadth of the Building.

Some make them flatter, as a Pediment Pitch, and the old *Gothick* Way, was to make them the whole Breadth; but some Authors take the middle Path between both Extremes of three fourths of the Breadth of the Building, and Pediment Pitch, making the Pitch or Perpendicular Height to be two sevenths of the Breadth of the Building, within Side; and the Length of the Rafter four sevenths, being of the Breadth of the Building, or twice the Perpendicular Height of the King Post.

Indeed *Palladio* says, the Breadth of the Place to be roofed, must be divided into nine Parts, two of which shall be the Pitch; for, says he, if the Roof were made one fourth of the Breadth, it would be too steep.

But it is to be observ'd, that *Palladio* speaks of *Italy*, or of Southern Climates, for he says in *Germany* where the Snow falls in great Quantities, the Roofs are made very sharp, and are cover'd with Shingles, &c. for otherwise the Weight of the Snow would crush them.

The Height of the Pitch of a Pediment, is one fourth of the Breadth of a Building, which is esteemed in *England* rather too flat, especially for Tileing: therefore some make Use neither of that Proportion, nor of the third of the Breadth of the common Pitch, and use a Medium Proportion between the two Extremes, &c.

Example. Suppose a Building to be ten Foot broad Work, according to the following Table.

If the Breadth of the Building be — Feet.	The Pediment Pitch $\frac{1}{4}$ perpendicular Height — Feet.	Inches.	The common one, $\frac{1}{3}$ perpendicular Height — Feet.	Inches.	The Medium $\frac{2}{7}$ perpendicular Heights — Feet.	Inches.
10	2	6	3	4	2	10$\frac{1}{4}$
12	3	0	4	0	3	6
14	3	6	4	8	4	0
16	4	0	5	4	4	6$\frac{1}{2}$
18	4	6	6	0	5	2
20	5	0	6	8	5	8$\frac{1}{2}$
22	5	6	7	4	6	3$\frac{1}{2}$
24	6	0	8	0	6	10$\frac{1}{4}$
26	6	6	8	8	7	5
28	7	0	9	4	8	0
30	7	6	10	0	8	7
32	8	0	10	8	9	2
34	8	6	11	4	9	8
36	9	0	12	0	10	4$\frac{1}{2}$
38	9	6	12	8	13	10$\frac{1}{2}$
40	10	0	13	4	11	5

The Use of the Table is, if the Span or Breadth of a Buliding is 26 Feet, the Perpendicular Height of a Roof, Pediment Pitch is six Feet, six Inches; if the common Pitch, eight Feet, eight Inches, the Medium of which is made to be seven Feet, 5 Inches, for the following Reasons.

The common Pitch, is not only unpleasing to the Eye, but is attended with this Inconvenience, if there be a Gutter round the Building, the Steepness of the Roof occasions Rain to come with so sudden a Velocity and Force into the Pipes, which are to convey the Water from the Gutters, that it fills the Gutters, and sometimes to that Degree, that the Water runs under the Covering of the Roof, and very much endamages the Timber, &c. of the Building, and the steeper the Roof is, the longer the Rafters, and the greater Quantity of Timber must be us'd in the Roof, as well as the more Weight from the greater Quantity of Timber, and the weakening the principal Timbers by adding more to its own Weight.

And the Pediment Pitch is inconvenient in lying too flat for these Climates so frequently subject to Rain and heavy Snows, which last would vastly press and incommode a Building, and would lie much longer on the Roof; its Declivity being so small; besides in strong Winds, attended with Rain, the Rain would drive under the Covering of Tiles or Slates, &c. and cause great Decay of the Timber.

In Order to avoid these inconveniencies, the Medium between the two Extremes may be taken, according to the following Tables, in which some are made stronger than others; that the Method may be made Use of, as Necessity requires, and Time is allow'd to perform it in.

Take the following Rule for the Proportion of Beams, whose Bearing varieth.

If the Beam bear in the Clear	Feet.	The Scantling must be	Inches.		Inches.
	12		6	and	8
	16		6¼	and	8½
	20		6½	and	9
	24		7	and	9½
	28		7½	and	9½
	32		8	and	10
	36		8½	and	10½
	40		8½	and	11
	44		9	and	12

Of Roofs in General, observe the following Examples.

Fig. 1. is an Hexagon Plan, and an *o g* Rafter.

First, Draw the Plan *a b c d e f*, also the Line *b h*, then middle *a b* at *i*, and draw the Line *i h*; then will *b h* be the Base of the Hip, and *i h* the Base of the Rafter; from *h* draw a Line to *k*, perpendicular to *i h*, and equal in Length to the Perpendicular of the Rafter; also from *h* draw a Line to *g*, Perpendicular to *b h*, and equal to *h k*; then draw the Moulding Part of the Rafter *i k*, in what Form you think proper;

proper; so done, divide the Line *i h* any how, from which Divisions raise perpendicular Lines to touch the Curve Line *i k*; continue those Lines to touch the Line *b h*, as the dotted Lines in the Example shew, which will divide the Line *b h*, into the same Number of Parts and Proportion with the Line *i h*; then from those Divisions raise perpendicular Lines at Pleasure, and take the perpendicular Line 1 . 1 on the Line *i h*, to the Curve of the Rafter *i k*, in your Compasses, and set it up the correspondent perpendicular Line, on the Line *b h*, as 1 . 1, also the Line 2.2, and 3 . 3, and so of all the rest; and in each of those Points, stick a Nail, and bend a thin Lath round them, to touch them all at once; then on the Edge of it, draw the Curve of the Hip *g b*, which was to be done.

Fig. 2, represents the Hip *b g*, in Fig. 1. and 1 2 3 4 at the Point *e*, represents the Sole of the Foot of the Hip, before the Back is work'd.

First, Draw Lines on the Hip, at any convenient Distance, parallel to the Foot or Base *a c*, Fig. 2. then draw the Sole of the Foot of the Hip, as 1 2 3 4 at the Point *e*, in Fig. 1, and take in your Compasses the Distance between the Point 1, to the Line *e f*; or from 2, to the Line *e d*; and set it from the Back of the Hip *a b*, on those parallel Lines as you see mark'd by Dots on them; then strike a Nail into each of those Dots or Points, and bend a thin Lath, to touch them all at once, and on the Edge of it strike a Curve Line; then draw a middle Line, down the Back of the Hip, and between that Line and the Curves created by those Dots, hew off the superfluous Wood, which will make the true Back of the Hip, and so of all other Roofs, in what Form soever; but only observe if your Plan is bevel, as one End of Fig. 5, to set the Superfluity of the Sole of the Hip, at the Point *c*, which is from 3, to the Line *c b*; and from 4 to the Line *c d*, on their proper Sides of the Hip; because one Side will be wider than the other, which is the Case on the Back of all bevel Hips.

The Plan *a b c d e f*, in Fig. 3. is a Hexagon, the same as Fig. 1. and the Lines *b h*, *g h*, *h k* and *h i*, in the one is equal to *b h*, *i h*, *h g* and *h k*, in the other, so are the Soles of the Feet of the Hips 1 2 3 4, at the two Points *e*, and there is no other Difference than the Curves of the Rafters, and consequently needs no other Explanation; and so of the two Hips, Fig. 2. and Fig. 4. the two last Figures being laid down only for Variety Sake.

The Design of the Gable End or Roof B. Plate 2.

Let the whole Breadth of Gable End or Roof A A be 20 Foot; divide the same into

four equal Parts, take three thereof for the Length of the principal Rafter A B, and placing that Perpendicular from the Point C to the Point D, begets the Length of the Sleeper A D which will be 18 Foot. And the Length of the Dormer's principal Rafter from A to E, when laid to its Pitch upon the Back of the Principals, will reach to the Level Line F B or Top of the principal Rafter; and this is a general Rule for all Breadths.

1. Summer or Beam.

2. King-Piece, Crown Post, or Joggle Piece.

3. Braces or Strutts.

4. Principal Rafters.

5. The Sleeper.

6. Purlin of the Dormer.

7. Principal Rafter of the Dormer.

8. Single Rafter of the Dormer, standing on the Sleeper and Purlin.

9. The Point of the Sleeper.

10, 11. The Thickness of the Wall and Lintels or Wall Plates.

Of flat Roofs. Plate 3.

Within a Chamber Beam and Rafters joggled in, whose Weight lieth not chiefly in the middle, and may be so made, that without hanging up the Beam, the Principals may discharge the Weight, and how Drips may be made to walk on.

A Draught of a Flat Roof with a Crown or King Post.

The Breadth of the House, *Cantalivers*, *Cornices* and *Eaves*, the Length of the Raftings and Curvings, which ought to be $\frac{3}{4}$ of the Breadth House.

The Principal Rafters are to be cut with a Knee (as in the Design) that they may the better support themselves, and the Burthen over them; upon the Upright of the Wall, and also secure that Part from the dripping in of the Rain, which otherwise would happen if the Rafters were made plain and furred.

The Beam to the Roof or Girder to the Garret Floor, ought to project without the Work as far as the furring or shreading, which is the Projecture of the *Cornice*.

1. Chamber Beam.

2. Principals joggled into the Chamber Beam.

3. The Place where the Principals are joggled in.

4. Puncheons or Braces.

5. Drips to walk on, and may be made with the less Current, that the Roof may be made the more Pitch, for the Strengthening thereof; and may be made higher or lower, according to the Building and Discretion of the Architect.

6. Battlements.

This Manner of framing the Roof will be useful, from 20 to 30 Foot, or thereabouts.

1. Ground Plate.

2. Girder or Binding, interduce or Bressummer.

3. Beam to the Roof, or Girder to the Garret Floor.

4. Principal Posts, and upright Brick-wall.

5. Braces.

6. Quarters.

7. Inter-

7. Interduces.
8. Prick-Post or Window-Posts.
9. Jaumbs or Door Posts.
10. King-Piece or Joggle-Piece.
11. Struts.
12. Cellar-beam, Strut-beam, Wind-beam or Top-beam.
13. Door-hand.
14. Principal Rafters.
15. Furrings or Shreadings.
16. Ends of the Lintels and Pieces.
17. Bedding Moulding of the Cornice, over the Windows and Space between.
18. Knees of the Principal Rafters, which are to be of one Piece.
19. Purline.

ROOF. How to find the Length of the Sleepers to a Dormer Roof.

a c is the Width or Spand of the Roof, and *a b* and *c b*, is the Pitch of the Rafters; *i g* and *k d*, shews the Back of the Roof on which the Sleepers are to lie, and are equal to *a b* and *c b*, and *i a c* is the Plate or Beam, on which the Rafters *a b c b* stand.

First, Draw the Gable End or Rafters *a b* and *c b*, and divide them in the middle at *a c* and *e*; from whence raise a Perpendicular at Pleasure, towards *f*.

Then take the Length of the Rafter in your Compasses, and set it on the Perpendicular at *e* from *e* to *f*; and draw *f i* and *f d*, which are the Length of the Sleepers sought for.

The Names of the Timbers.

I. Beams. II. Principal Rafters. III. Cellar Beams. IV. King Posts. V. Prick-Posts. VI. Struts. VII. Sleepers. VIII. Purlings. IX. Small Rafters.

ROOFING in ordinary Buildings is worth 7 or 8 *s. per* Square; but in great Buildings 10 or 11 *s. per* Square. See *Framing*.

Roofing is commonly measured by the Square, as Flooring.

ROSE [in *Architecture*, &c.] is an Ornament cut in the Resemblance of a Rose.

It is chiefly us'd in Friezes, Cornices, Vaults of Churches, and particularly in the middle of each Face of the *Corinthian* Abacus. And in the Spaces between the Modillions under the Plafonds of Cornices.

ROSE-NAILS. See *Nails*.

ROTATION [in *Geometry*] is the Circumvolution of a Surface, round an immoveable Line, call'd the Axis of Rotation.

ROTATION [in *Mechanicks*] Rolling, or turning round.

ROTHER NAILS. See *Nails*.

ROUGH STONE. See *Rag-Stone*.

ROUGH CASTING. See *Plaistering*.

ROUGH *Mortar* is us'd in many Places in *Kent*, &c. and is made with a Sort of Sand, which when it is mix'd with the *Lime*, makes it look as red as Blood, but with these they mix Powder of Cinders, which

changes it to a kind of blueiſh Colour, with this they rough caſt their Houſes.

ROUND HEADS. See *Nails*.

RUDENTURE [in *Architecture*] is the Figure of a Rope or Staff ſometimes plain, ſometimes cut carved, with which the third Part of the Flutings of Columns, are ſometimes fill'd up.

There are alſo *Rudentures* in *Relievo*, laid on the naked of Pilaſters, not Fluted, an Inſtance of which we have in the Church of St. *Sapienzia*, at *Rome*.

RUDENTURES ſays M. *Le Clerc*, are cut, on ſome Occaſions in the Flutings, to ſtrengthen their Sides, and render them leſs liable to be broken.

For Inſtance, when Fluted Columns or Pilaſters are made without Pedeſtals, and plac'd on a Level with the Ground; or at leaſt ſo little rais'd, as to be without the reach of the Hand; their Flutings muſt be rudented or cabled (as they call it) as far as one third of their Height; that is, they muſt be fill'd up one third Part to that Height with theſe Rudentures, in Order to ſtrengthen the Sides, which might otherwiſe be ſoon defac'd.

Theſe Rudentures, which were at firſt invented for Uſe, ſays M. *Le Clerc*, have been ſince converted into Ornaments to enrich the Flutings, ſo that inſtead of plain ſubſtantial Rudentures, we now frequently ſee them exceedingly weak and ſlender, being wrought in Form of twiſted Ribbons, Foliages, Chaplets, and other rich and delicate Ornaments.

But this kind of Rudenture ſays he, ſhould never be us'd except in Columns and Pilaſters of Marble, and ſuch as are beyond the reach of the Hands of the People.

One may likewiſe for the greater richneſs, as well as for the Sake of the greater Eaſe, make theſe Ornaments of Braſs gilt, to be fitted wichin the Flutings.

Theſe delicate Ornaments are alſo found to ſucceed very well in Columns and Pilaſters of Wood; where they are cut with a great Deal of Eaſe and Juſtneſs

RUDERATION [in *Building*] is a Term us'd by *Vitruvius* for the laying of a Pavement with Pebbles.

To perform the *Ruderation*, it is neceſſary that the Ground be well beaten to make it firm and to prevent it from cracking. Then a *Stratum* of little Stones are laid to be afterwards bound together with Mortar made of Lime and Sand.

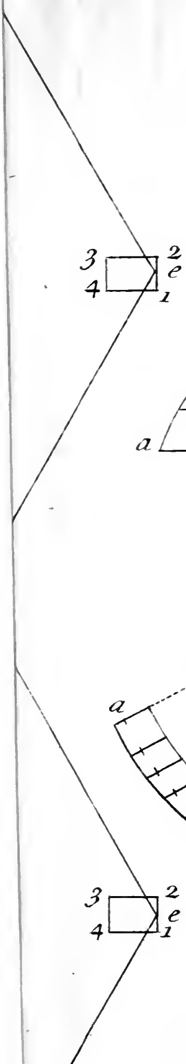
If the Sand be new, its Proportion may be to the Lime as 3 to 1, if dug out of old Pavements or Walls, as 5 to 2.

RUDERATION as *Daviler* obſerves, is us'd by *Vitruvius* for the courſeſt and moſt artleſs kind of Maſonry, where a Wall is, as it were, cobbled up.

RULE, a ſimple Inſtrument, ordinarily of hard Wood, thin, narrow and ſtrait, ſerving to draw Lines withal.

A

Plate XXIII.



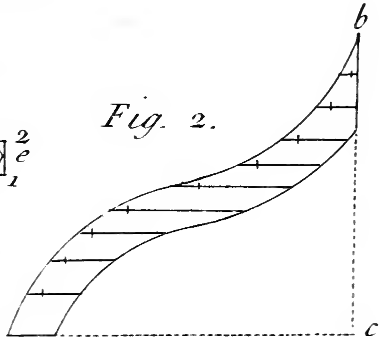


Fig. 2.

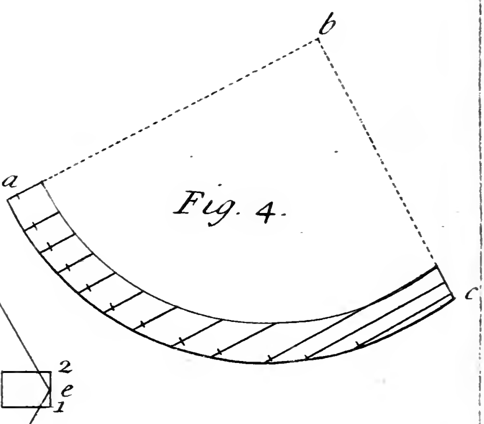


Fig. 4.

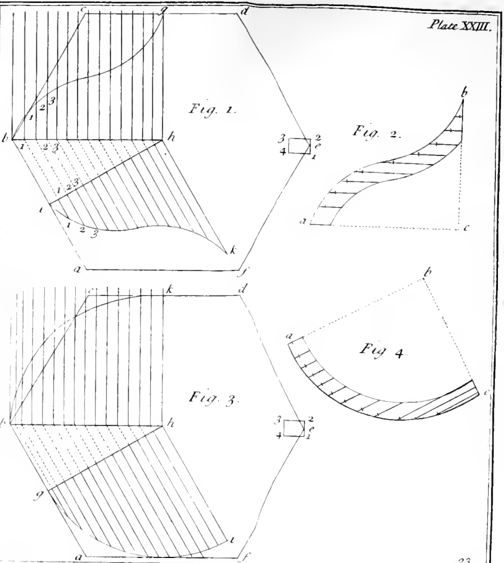


Fig. 1.
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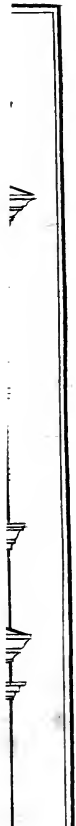
Fig 4.



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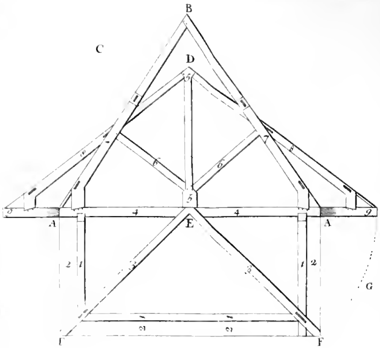
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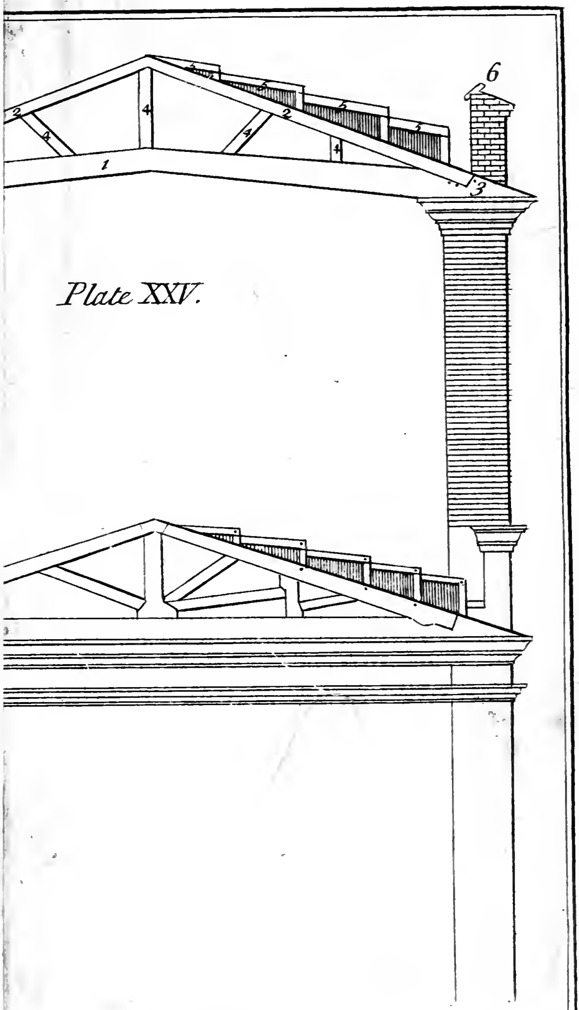
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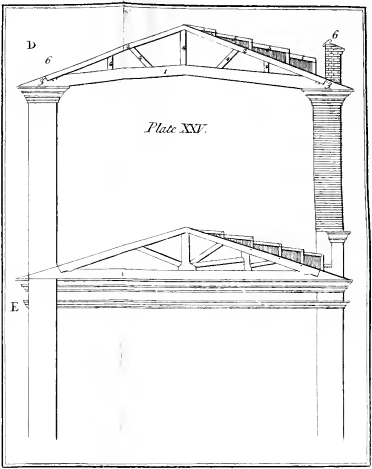
Plate XXV.



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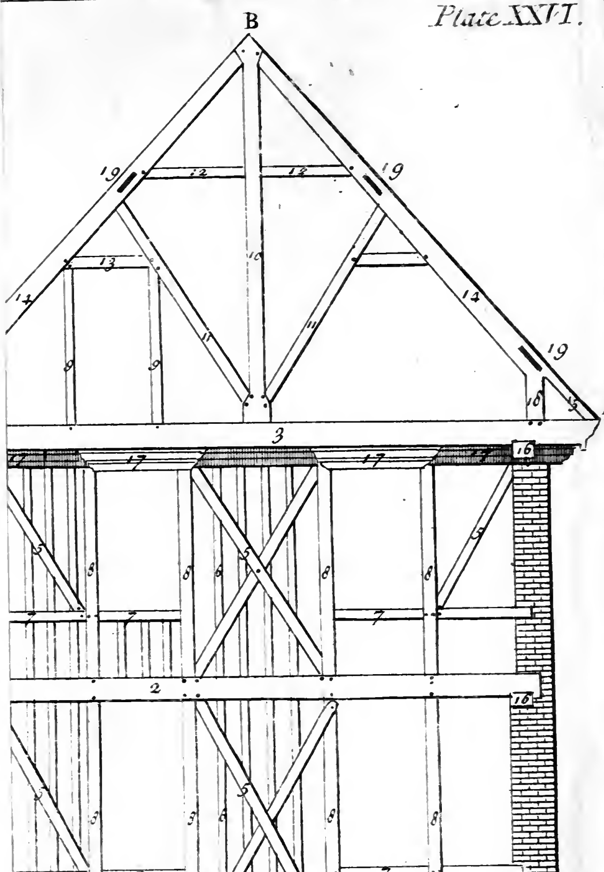
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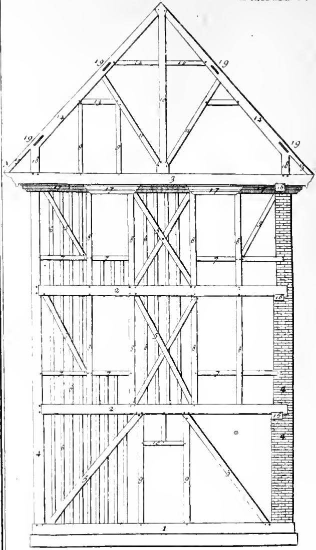
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A Masons Rule is 12 or 15 Foot long, and is apply'd under the Level for regulating the Courses, and for making the Piedroits equal.

A Stone-Cutters Rule is ordinarily four Foot long, and divided into Feet and Inches.

Carpenters Rule is an Instrument most commonly made of Box Wood, 24 Inches long and one and a half broad; each Inch being subdivided into 8 Parts. On the same Side with these Divisions, is usually *Gunter's Line* of Numbers.

On the other Side are the Lines of Timber and Board Measure, the first beginning at 82, and continued to 36, near the other End: The latter is numbred from 7 to 36 4 Inches from the other End.

The Use of Coggleshal's *Sliding* Rule *in the Mensuration of Artificers Work.*

This is generally plac'd upon one Side of one Leg of a two Foot Rule, consisting of four Lines.

Of which two Lines are plac'd on a Slip or sliding Part, and the other two upon the Leg of the Rule, and are thereby fix'd.

These last two Lines plac'd on the Rule, shall be hereafter in Practice call'd the *Stock*, and the two middle Lines, the *Slip*.

2. The uppermost Line on the Stock, and the two Lines on the Slip are all alike numbred, *viz.* from 1, 2, 3, &c. to 1 in the middle, and from thence to 10 at the End, and the undermost Line from 4, 5, 6, &c. to 40, which is the Square Line, and when us'd in Timber, the Girt-line.

3. Take Notice also, that the Lines on the Slip, and that next above it, are each divided between 1 and 2 into 10 Parts, and each tenth is subdivided into 5 Parts, and consequently the whole Division contain'd between 1 and 2, is thereby divided into 50 Parts, and if each Division be suppos'd to be again subdivided or equal to 2; then the whole Space may be said to be divided into 100 Parts.

4. The Spaces between 2 and 3, and between 3 and 4 are each decimally divided into 10 Parts, as before; and as the Distance between 2 and 3 is less than between 1 and 2, therefore these tenths are each subdivided into two Parts, and consequently the whole Space between 2 and 3, will be divided but into 20 Parts; and if each Part be accounted to be divided into five lesser Parts, or each = 5, then the whole Space between 2 and 3, may be or suppos'd to be divided into 100 Parts, as before between 1 and 2.

5 The other Divisions between 4 and 5; 5 and 6; 6 and 7; 7 and 8; 8 and 9, being yet lesser and lesser, are therefore divided into 10 Parts only; wherefore accounting each Part equal to 10, then every of these Divisions may be suppos'd to be divided into

100 Parts, as the Preceeding.

6. The remaining Length from 1 in the middle, to 10 at the End. is divided reſpectively after the ſame Manner, as alſo are the reſpective Diviſions of the Girt Line on the Stock, which are contain'd between the beginning of it at 4 to 10; but the Diviſions from 10 to 40, are firſt each decimally divided into tenths, and each tenth ſubdivided into 4th Parts.

At the Girt Line, juſt at the Beginning before 4, there are two Diviſions, each ſubdivided into four Parts; and at the End beyond 40, there are two, each ſubdivided into two Parts.

Theſe two Diviſions at the End of the Line beyond 40, each ſubdivided into two Parts, are the ſame as the firſt two Diviſions divided into halves, that are next after 4 at the beginning of the Line, that is, if you ſuppoſe that from 40 the whole Line was immediately to begin again, placing 4 the Beginning in the Place of 40 at the End, then thoſe two Diviſions would repreſent the firſt two Diviſions between 4 and 5.

Likewiſe the two Diviſions ſub-divided into four Parts, plac'd before 4 at the Begining are equal to the two laſt Diviſions, next before 40, at the End.

That is, ſuppoſing that the Space between 30 and 40 at the End of the Line was to be prefix'd before 4 in the beginning, then would the two laſt Diviſions before 40, be in the ſame Place of the two Diviſions before 4.

To number or expreſs Quantities, on this Rule obſerve

1. Let the Space between 1 at the beginning of the Line, and 1 in the middle, repreſent one Integer, as one Foot or one Inch, &c. then will 1 at the beginning, ſignify $\frac{1}{10}$ thereof; 2 will ſignify $\frac{2}{10}$; 3 will ſignify $\frac{3}{10}$, and ſo on; and laſtly the 1 in the middle 1 Integer as aforeſaid; and as before was ſhewn, that every ſuch principal Diviſion of 1, 2, 3, 4, 5, 6, 7, 8, 9; 1 was ſeverally divided into 100 Parts, therefore this Integer is divided into 1000 Parts.

2. The following Diviſions from 1 in the middle, as 2, 3, 4, 5, 6, 7, 8, 9, 10, are ſeverally whole Integers; that is, when the Space from 1, in the beginning to 1 in the middle, is reckon'd the Integer, then the 2 following, ſignifies two Integers; the 3, ſignifies three Integers, &c. and ſo conſequently the End of the Line, ſignifies ten Integers, and their reſpective ſub-diviſions, repreſent their fractional Parts, as has been before ſhewn in the firſt Integers.

3. But if 1 at the beginning of the Line be accounted an Integer or one, then the 2 following ſignifie two Integers; the 3 following, three Integers, &c. and the 1 in the middle ſignifies 10 Integers.

Now as the two following, the 1 in the middle, did before repre-

represent 2, when the 1 in the middle represented one Integer, so now will the same 2 represent 20, when the 1 in the middle represents ten Integers, and consequently the following numbers, 3, 4, 5, *&c*, to 10, will represent so many hundred Integers to 1000; so in like Manner, if the Line be began with 100, then the 1 in the middle will represent 1000, and the 10 at the End, 10000, *&c*.

4. When the Line is begun with 1, and the middle one signifies 10, then every Decimal or tenth Division following between 1 and 2, between 2 and 3, *&c*. will represent an Integer.

Thus the first tenth Division after 1, in the middle signifies 11, the second tenth, 12; which is number'd 12 with a smaller Figure than the others, and sometimes only distinguish'd by four Points thus : : and in like Manner of all others, of which every fifth is distinguish'd by a longer Stroke than the others, as 15, 25, 35, *&c*. and the Subdivisions of each Integer, are fractional Parts thereof.

5. When the Line is begun with 10, then every tenth Division between 1 and 2, between 2 and 3, *&c*. does each represent an Integer (as has been said before of the tenths following the middle of the Line) thus the first tenth after 1 at the beginning, signifies 11, the second tenth, 12, the third tenth, 13, *&c*. (which has its Division longer than the others, as aforesaid) the sixth tenth, 16, *&c*.

The Uses of this Rule in Measuring.

1. To multiply one Number by another.

The Analogy is,

As 1 is to the Multiplier : : so is the Multiplicand to the Product.

Example 1. Multiply 7 by 9.

Practice. Begin the Line 1, and set 1 on the Slip, to 7 the upper Line of the Stock, and against 9 on the Slip, stands 63 on the upper Line of the Stock, which is the Product requir'd.

Example 2. Multiply 10 by 12.

Practice. Begin the Line with 10; set 1 on the Slip to 10 on the Stock, and against 12 on the Slip, stands 120 on the Stock, which is the Product requir'd, and so in like Manner any other Number given.

To perform Division by Rule.

The Analogy is,

As the Divisor is to 1. : : so is the Dividend to the Quotient requir'd.

Practice. Divide 72 by 9. begin the Line with 1, place the Divisor 9 on the Stock against 1 on the Slip, and against 72 on the Stock, stands 8 on the Slip, which is the Quotient required.

Example 2. Divide 630 by 15. Begin the Line with 10, then againſt the Diviſor 15 on the upper Line of the Stock ſet 1 on the Slip, and againſt 630 on the Stock, ſtands 42 on the Slip, which is the Quotient requir'd.

The Rule of Three, *by the Sliding Rule.*

The Analogy is,

As the firſt given Number is to any other Number (as 5 is to 11, *&c.* ſo is the ſecond given Number (as 10) to a fourth Number, which is the Number ſought for in the ſame Proportion.

Example 1. If five Men are paid 11 Pounds for one Weeks Work, what muſt ten Men receive for the ſame Time, at the ſame Rate?

Practice. Begin the Line with 1, then ſet 5 on the Slip againſt 11 on the Stock, and againſt 10 on the Slip ſtands 22 on the Stock, which is the Anſwer of the Queſtion.

Example 2. If the Diameter of a Circle be 7 Feet, whoſe Circumference is 22 Feet, what is the Circumference of another Circle, whoſe Diameter is 22 Feet?

Practice. Begin the Line with 1, then ſet 7 on the Slip, againſt 22 on the Stock, and againſt 21 on the Slip, ſtands 66, the Circumference requir'd.

Example 3. If 21 Bricks pave one Yard ſquare, how many Bricks will pave 30 Yards.

The Analogy is as 1 is to 21, ſo is 30 to the Number requir'd.

Practice. Set 1 on the Slip to 21 on the Stock, and againſt 30 on the Slip, ſtands 630 the Anſwer of the Queſtion.

Now in working of the Rule of Three direct, as in the preceeding Examples, you ſee, that as the ſecond Number is always greater than the firſt; the fourth Number will be always greater than the third; and *e contra.*

And in the Rule of Three Inverſe, as in the following Example; if the ſecond be leſs than the firſt, the fourth will be leſs than the third; and *e contra.*

Example 4. If the Circumference of a Circle be 44 Feet, what will the Diameter of another Circle be, whoſe Circumference is 66 Feet?

The Analogy is as 44 to 14 : : So is 66 to the Number requir'd.

Practice. Begin the Line with 1, and againſt 44 on the Stock, ſet 14 on the Slip, then againſt 66 on the Stock, ſtands 22 on the Slip, which is the Diameter required.

Now from theſe Examples, it is plain that the ſecond and third Numbers are never taken on the ſame Line which is always to be remembred.

It

It is also to be obſerv'd.

If in placing the firſt Number to the ſecond, the third falls beyond the Line, take the third Number in the firſt Part, or the other Length of the Line, as if it was continued; giving it its Value, according to its Place, as before ſhown.

Of the Extraction of the Square Root.

By the Help of the lowermoſt Line on the Stock, before call'd the *Square Line* or *Girt Line*, the Square Root of any Number not exceeding 10000, may be very readily found, a follows.

Practice. Begin the lowermoſt Slip of the Line with 10, and ſet 16 thereof to 4, the beginning of the Square Line, then the Numbers of the Square Line will be the Square Roots of the Numbers contain'd in the lower Line of the Slip; or thoſe Numbers in the Slip, will be the Squares of thoſe of the Girt Line on the Stock.

Thus againſt 5 on the Girt or Square Line, ſtands 25 on the Slip, and againſt 6 on the Girt, ſtands 36 on the Slip: So in like Manner.

$$\text{againſt} \left\{ \begin{matrix} 7 \\ 8 \\ 9 \\ 10 \\ 20 \\ 30 \end{matrix} \right\} \text{ſtands} \left\{ \begin{matrix} 49 \\ 64 \\ 81 \\ 100 \\ 400 \\ 900 \end{matrix} \right\} \begin{matrix} \text{which are the} \\ \text{Square Num-} \\ \text{bers of} \end{matrix} \left\{ \begin{matrix} 7 \\ 8 \\ 9 \\ 10 \\ 20 \\ 30 \end{matrix} \right\}$$

Hence 'tis plain that any given Square Number, under 1000 being found in the lower Line of the *Slip*, its *Square* Root or Side of its Square is that Number in the *Square* or *Girt-Line*, which is oppoſite to it.

2. Remove the Slip, and place its beginning 1 to 10 on the *Square* or *Girt-Line*, and accounting 1 the beginning of the Slip, as 100, then 40 on the *Square* or *Girt Line* ſtand againſt 1600 its Square in the *Slip*, and thus you have the Root of any Square Number under 1600.

3. Remove the Slip to its firſt Station, placing 16 on the Slip (beginning the Line with 10) againſt 4 the beginning of the *Square Line*; and then reckoning the ſaid 16 in the Slip to be 1600, and the 4 in the *Girt-Line* againſt it to be 40; as when thoſe Numbers were together at the other End in their laſt Station; then will the Square Numbers in the Slip go on from 1600 to 10000, whoſe Roots are contain'd in the Square Line oppoſite thereto: thus

Thus

Thus the Square Root of	1600 2500 3600 4900 6400 8100 10000 40000 90000	is	40 50 60 70 80 90 100 200 300&c.	as exhibited by the opposite Divisions in the *Square* or *Girt-Line*.

And removing the Slip as at the second Operation, you may continue the square Numbers to 160000; and then altering the Slip as at the third Operation, you may continue them from 160000 to 1000000, and so on in like Manner *ad infinitum*.

To measure the Dimensions of Mason's Work by the Sliding Rule.

The Analogy for Foot Measure is as follows.

As 12 on the upper Line on the Stock, which in Foot Measure is always fix'd, and therefore noted with small Figures, (as has been before noted) is to the Dimensions Length in Feet and Parts of Feet accounted on the Slip.

So is the Breadth in Inches accounted on the upper Line of the Stock.

To its Content in Feet on the Slip.

Example. A Piece of Marble Pavement is 36 Foot and half in Length, and 33 in Breadth, what is the Superficial Content?

Practice. Set the Length 36 Feet and a half on the Slip to 1, the upper Line of the Stock, and against 33 on the Stock, shall stand 100, $\frac{1}{3}$ the Content requir'd.

And here it is to be observ'd, that when Fractions happen, as in this Example, they ought to be estimated as near to the Truth as can be, which in Practice of Business is near enough for our Purpose.

But to determine the true Quantity or Value of Fractional Quantities (it being impossible to be done by this Rule) you must have recourse to Vulgar or Decimal Arithmetick.

Example 2. In a *Portland* Slab 8 Feet 3 Inches long, and $17\frac{1}{2}$ Inches broad, how many Feet does it contain?

Practice. Set the Length 8 Feet 3 Inches on the *Slip* (which is 8 and $2\frac{1}{2}$ of the Subdivision of the Tenths) to 12 on the upper Line of the *Stock*, and against $17\frac{1}{2}$ on the *Stock* stands 12 and a very little more, which is equal to $4\frac{1}{2}$ square Inches, the true Content required.

And so in the like manner any other Quantities, as given.

The

The next in Order is ſolid Meaſure; which Buſineſs generally happens under the Forms of the Cylinder, the Cube, and the Parallelopipedon.

Of the *Cylinder*, the Analogy is as follows.

As the Length in Feet and Inches accounted in the lower Line of the Slip,

Is to 10, 635. accounted on the *Girt Line*;

So is $\frac{1}{4}$ of the Circumference or Girt in Inches,

To the ſolid Content in Feet required.

Example, In a Cylinder of Stone, 28 feet 9 inches long, and 15 Inches $\frac{1}{4}$ of its Girt or Circumference; what Number of ſolid Feet does it contain?

Practice. Set the Length 28 feet $\frac{3}{4}$ in the *Slip* to 10.635 in the *Girt Line*, and againſt 15 the Quarter of the Cylinder's Girt, accounted on the Girt Line, ſtands 61 on the *Slip*, which is the ſolid Content required.

Of the *Cube*, the Analogy is as follows.

As the Length or Side of the Cube in Feet and Inches accounted in the lower Line of the *Slip*,

Is to 12 accounted on the *Girt Line*,

So is the Depth or Side of the *Cube* in Inches, accounted in the *Girt Line*, to the ſolid Content in feet accounted on the *Slip*.

Example. There is a *Cube* of Stone, whoſe Side is $2\frac{1}{2}$ feet; what is the ſolid Content of it?

Practice. Set the Side of the Cube $2\frac{1}{2}$ feet, accounted on the *Slip*, to 12 on the *Girt Line*, and againſt 30 the Side of the Cube in Inches (which is equal to $\frac{1}{4}$ of its Girt) ſtands $15\frac{1}{2}$.

Of the *Parallelopipedon* the Analogy is the ſame as before of the *Cube*.

As the Length of the *Parallelopipedon* taken in feet and inches, accounted on the lower Line of the *Slip*,

Is to 12, accounted on the *Girt Line*,

So is half of the Girt of the Parallelopipedon in Inches accounted on the *Girt Line*, to the ſolid Content in Feet accounted on the Slip.

Example. There is a long Cube or Parallelopipedon, whoſe Length is 17 feet 9 inches and $\frac{1}{4}$ Part of the Girt accounted on the *Girt Line*, and againſt $22\frac{1}{2}$ inches the $\frac{1}{4}$ of the Girt accounted on the Girt Line ſtands 66 in the Slip, which is the ſolid Content requir'd.

But here it is to be remembred that, if the Baſe of the *Parallelopipedon* is not exactly ſquare; having its Breadth greater or leſs than its Depth, then its Depth will, by taking $\frac{1}{4}$ of the Girt, not give the true Solidity.

But in ſuch caſe you muſt find a mean Proportional between the Breadth and the Depth;

Depth: and this being done, you may then proceed as if the Breadth and Depth were equal.

A mean Proportional is a Number, which being squar'd or multiplied into it self, produces the same Quantity that two given Numbers would do, being multiply'd into one another, to which it is a mean Proportional; or otherwise it is the square Root of the Product produc'd by the Multiplication of the two unequal Sides into one another.

Suppose the Breadth of the Parallelopipedon be 9 inches, and the Depth 4 inches. I say, if the 9 be multiply'd by 4, the Product will be 36; and the mean Proportional between 4 and 9 is 6; for 6 times 6 is 36, which is equal to 4 times 9: Therefore 6 is the mean Proportional between 4 and 9.

Now suppose the Dimensions be as before, *viz.* 9 inches in Breadth, and 4 in Depth, and consequently is 26 inches in Girt; of which, if you take $\frac{1}{4}$ Part, *viz.* 6 $\frac{1}{2}$ for the Side of the Square, as in the Square Parallelopidedon, it is plain that it will produce a content too great for 6 $\frac{1}{2}$ multiply'd by 6 $\frac{1}{2}$ will produce 42 $\frac{1}{4}$, which is 6 $\frac{1}{2}$ too much in the Area, and that being multiply'd into the Length would carry on the Error much higher.

Hence it is evident, that to Measure an unequal Parallelopipedon, there must first be a mean Proportional found, which may be easier produced from the square Root of the Area of the Base, or as follows.

Set the greater of the 2 Numbers (as here 9) on the Square or *Girt-line* to the same Number 9 on the *Slip*, against the less Number 4 accounted on the *Slip*, stands the mean Proportional (6) on the square Line.

Or thus,

Set the less Number (4) on the same Number (4) on the square Line, and against the greater Number (9) accounted on the *Slip*, stands the mean Proportional (6) on the square Line as before.

The Mensuration of *Bricklayers* Work by this Rule.

Bricklayers Work is measured by the Foot, Yard, Square, and Rod.

In Yard Measure, the first stated Number must be 9, and for Rod Measure 272, which in Foot Measure is but 12, and in Order to these Operations it will be necessary to have a little Brass Stud fix'd in the upper Line of the *Stock* and *Slip* at 9, and 272 and $\frac{1}{4}$, whereby those Centre-points (as Workmen call them) or first Numbers will be readily found.

In *Yard Measure* you must take Notice that the Dimensions are taken in Feet and Quarters of Feet.

The Analogy in *Yard* Measure is,

As the fixt Number 9 accounted on the upper Line of the *Stock*.

Is to the Breadth in Feet accounted on the *Slip*; so is the Length accounted on the *Stock*, to the superficial Content on the Slip.

Example 1. If a Cellar be pav'd with paving Bricks, the Length of which is 15 Feet $\frac{3}{4}$, and the Breadth 12 and $\frac{1}{4}$, what will be the superficial Content thereof?

Practice. Set the Breadth 12 Feet $\frac{1}{4}$ on the Slip to the fixt Number 9 on the *Stock*, and against 15 Foot $\frac{3}{4}$, accounted on on the Stock stand 21 $\frac{1}{3}$ on the *Slip*, which is the superficial Content requir'd.

Example 2. If 30 Bricks pave 1 Yard, how many Yards will 630 Bricks pave?

The Analogy.

As the Bricks of one Yard accounted in the *Stock*.

Is to 1 accounted on the *Slip*.

So is the Number of Bricks given, accounted on the *Stock* to the Yards, which they will pave accounted on the Slip.

Ptactice. Set 30 on the Stock to 1 on the Slip, and against 630 on the *Stock* stands 21 on the *Slip*, which is the Number of Yards that 630 Bricks will pave.

Of Square Measure.

In this the Dimensions are taken in Feet and Quarters of Feet as in Yard Measure.

By square Measure is meant a square Space, containing 100 square Feet, or it is a Geometrical Square, whose Side is equal to 10 Feet, and consequently the whole equal to 100 Feet.

By this Measure all Manner of Tileing and Slating is perform'd, as follows:

As the Breadth accounted on the *Stock*.

Is to 100 accounted on the *Slip*.

So is the Length accounted on the *Slip*, to the content accounted on the *Stock*.

Example. If a Roof be 70 Feet in Length, and 15 Feet in Depth from the Ridge to the Eaves, what is the Content of it.

Practice. Set the Breadth 15 accounted on the *Stock*, to 1 accounted on the *Slip*, and against the Length 70 on the *Slip*, stands 10 $\frac{1}{2}$ the Number of Squares therein contain'd, which is equal to 1050 square Feet.

This Product or Content is but $\frac{1}{2}$ the Quantity of Tileing if both Sides of the Roof are equal, therefore the 10 $\frac{1}{2}$ Squares being doubled, the Content of the whole will be found to be 21 Squares compleat.

And here it is to be noted, that as one Square is equal to 100 Feet.

Half a Square is equal to 50

A Quarter of a Square equal to 25

And half a Quarter of a Square equal to 12 $\frac{1}{2}$

Rod

Rod Measure.

Rod Measure is a square Measure consisting of 272 $\frac{1}{2}$ square Feet, produced by the Squaing of a Rod in Length, *viz.* 16 $\frac{1}{2}$ Feet multiply'd into itself its product is 272 $\frac{1}{4}$, the odd $\frac{1}{4}$ is rejected, and the 272 Feet only is reckoned a square Rod.

By this Measure are measured all Manner of Walls and Chimneys, which, tho' of various thicknesses, yet they are all measured as superficial Measure, being reduced to the Standard thickness of one Brick and Half.

By this Analogy.

As the Length accounted on the *Stock.*

Is to 272 accounted on the *Slip.*

So is the Height accounted on the *Slip* to the Content on the *Stock.*

Or thus,

As the fixt Number 272 on the Slip.

Is to the Length accounted on the Stock.

So is the Height accounted on the Slip to the Content on the Stock.

Glazier's Work.

Glaziers Measure their Work by the Foot Square, and take their Dimensions in Feet and 100 Parts of a Foot, and therefore on the Edge of Sliding Rules, the Foot is generally divided into 100 equal Parts, numbred, 10, 20, &c. to 100, and oftentimes the whole two Foot onwards from 100 to 200.

Sometimes Dimensions of Glass are taken in Inches and Quarters of Inches, tho' but rarely, which when they are so.

This is the Analogy.

As 144 which is the first and fixt Number for Foot Measure accounted on the Stock.

Is to the Breadth taken in Inches accounted on the Slip.

So is the Length accounted in Inches on the Stock to the Content on the Slip required.

Example. A Pane of Glass 31 Inches a half in Length and 8 $\frac{1}{2}$ Inches in Breadth, what is the Content?

Practice. Set the Breadth 8 $\frac{1}{2}$ in the Slip to 144 in the Stock, and against 31 Inches $\frac{1}{2}$ the Length stands 1. 85 in the Slip, which is the Content required.

The Use of the Carpenters joint Rule.

The Application of the Inches in Measuring Lengths, Breadths, &c. is obvious, that of *Gunter's* Line. See under the Line of NUMBERS.

The Breadth of any Surface as Board, Glass, &c. being given; to find how much in Length makes a square Foot.

Find the Number of Inches the

the Surface is broad in the Line of Board Meaſure, and right againſt it is the Number of Inches requir'd.

Thus if the Surface were eight Inches broad, 18 Inches will be found to make a Superficial Foot.

Or more readily thus apply the Rule to the Breadth of the Board or Glaſs; that Edge mark'd 36, being even with the Edge; the other Edge of the Surface will ſhew the Inches, and quarters of Inches, which go to a ſquare Foot.

The Uſe of the Table at the End of the Board Meaſure.

If a Surface be one Inch broad, how many Inches long will make a Superficial Foot? Look in the upper Row of Figures for one Inch, and under it in the ſecond Row is 12 Inches, the Anſwer to the Queſtion.

The Uſe of the Line of Timber Meaſure.

This reſembles the former, for it being known how much the Piece is ſquare; look for that Number on the Line of Timber Meaſure; the Space thence to the End of the Rule is the Length, which at that Breadth, makes a Foot of Timber: thus if the Piece be nine Inches ſquare, the Length that is requir'd to make a Solid Foot of Timber, is $21\frac{1}{3}$ Inches.

If the Timber be ſmall and under nine Inches ſquare, ſeek the Square in the upper Rank of the Table, and immediately under it are the Feet and Inches that make a ſolid Foot, thus if it be 7 Inches ſquare, 2 Foot, 11 Inches, will be found to make a ſolid Foot.

If the Piece of Timber be not exactly ſquare; but broader at one End than the other; the Method is to add the two together, and to take half the Sum for the Side of the Square.

For *Round Timber*, the Method is to girt it round with a String, and to allow the fourth Part for the Side of the Square. But this Method is erroneous, for by it there is loſt above $\frac{1}{5}$ of the true Solidity.

RULE of THREE }
RULE of PROPORTION } commonly call'd the GOLDEN RULE is a Rule which teaches how to find a fourth Proportional Number to three others given.

RUSTICK [in *Architecture*] a Manner of Building in Imitation of Nature, rather than according to the Rules of Art, the Columns are encompaſs'd with frequent Cinctures.

RUSTICK WORK, is where the Stones, *&c.* of the Face. *&c.* of a Building inſtead of being ſmooth, are hatch'd or pick'd with the Point of a Hammer.

RUSTICK ORDER, is an Order with *Ruſtick* Quoins, Ruſtick Work, *&c.* *Felibien* ſays, 'tis properly where the ſeveral Parts of the Five Orders are not exactly obſerv'd, but this confounds *Ruſtick* with *Gothick*.

S.

SAGITTA [in *Architecture*] *i. e.* an Arrow, which the *Italians* call *Saetta*, is what we call the Key-Piece of an Arch.

SALON } [in *Architecture*] is a very lofty ſpacious Hall, vaulted at Top, and ſometimes comprehending two Stories or Ranges of Windows, as that at *Blenheim* Houſe.
SALOON }

The *Saloon* is a grand Room in the middle of a Building, or at the Head of a Gallery, *&c.*

Its Faces or Sides ought all to have a Symmetry with each other; and as it uſually takes up the Height of two Stories, its Ceiling, as *Daviler* obſerves, ſhould be with a moderate Sweep.

The *Salon* is a State Room. Theſe are much us'd in the Palaces in *Italy*, and from them we took the Mode.

Saloons are frequently built ſquare, and ſometimes octogonal, as at *Marli*, and ſometimes in other Forms.

Embaſſadors and other great Viſitants, are uſually receiv'd in the State Room.

The Bottom of its Plafond ought to be arch'd, as is practiſed in ſome of the Palaces of *Italy*.

SAMEL or SANDEL *Bricks* See *Bricks*.

SAND, is a fine, hard, gravelly Earth of great Uſe in Building, and other Works.

There are three Sorts of Sand diſtinguiſh'd by the Places whence they are drawn, *viz. Pit-ſand*, *River-ſand*, and *Sea-ſand.*

Sand is us'd in Building, as one of the Ingredients in Mortar.

For this Uſe Pit-Sand is of all the beſt, and of Pit-Sand the whiteſt is always the worſt.

Of *River-ſand*, that found in the Falls of the Water is the beſt, becauſe moſt purged.

Sea-Sand is the worſt.

Pit-ſand, as being fat and tough, is moſt us'd in Building Walls and Vaults.

River-ſand, ſerves for *Rough Caſting*.

All Sand is good in its kind, if when ſqueez'd and handled it crackles, and if being put on a white Paper, *&c.* it neither ſtains nor makes it foul.

That Sand is naught, which mixt with Water makes it dirty, and which has been long in the Air; for ſuch will retain much Earth and rotten Humour. And for this Reaſon ſome Maſons waſh their Sand before they uſe it.

De Lorine obſerves, that the Sand of *Puzzuolo* is the beſt in the World, eſpecially for maritime Building.

Some diſtinguiſh Sand into *Male* and *Female*. The *Male* Sand is of a deeper Colour than another Sort of Sand in the ſame Bank or Bed, call'd *Female* Sand.

Founders make Uſe of Foſſil Sand. It is properly a yellow fat Earth, whereof they make their Moulds for the Caſting of ſmall Work, whence they call it *Caſting in Sand.*

The Plumbers uſe Sand in moulding

Moulding ſeveral of their Works, particularly large Sheets.

To prepare this Sand for their Sheets, they wet it lightly, ſtir and work it with a thick, and then they beat and plane it.

Sand at *London* is commonly ſold for 3 *s. per* Load, 36 Buſhels to the Load.

In ſome Parts of *Suſſex* and *Kent*, 'tis ſold for 18 *d. per* Load, at 12 Buſhels to the Load. In other Parts of *Suſſex* 'tis ſold at 2 *s.* 6 *d. per* Load, at 18 Buſhels to the Load.

SASH-LIGHTS. See *Painting*.

SASH-FRAME. See *Painting*.

SAW, is an Inſtrument ſerving to cleave or divide into Pieces divers ſolid Matters, as Wood, Stone, Marble, &c.

The Workmen who make the greateſt Uſe of the Saw are the Sawyers, Carpenters, Joiners, &c.

The beſt *Saws* are made of Steel, ground bright and ſmooth; thoſe of Iron are only Hammer harden'd; and thence the firſt, beſides their being ſtiffer, are likewiſe found ſmoother than the laſt.

You may know, whether or not they have been well hammer'd, by the ſtiff bending of the Blade; and if they have been well and evenly ground, by bending equally in a Bow.

The Edge in which the Teeth are, is always thicker than the Back, becauſe the Back is to follow the Edge.

The Teeth are cut and ſharpen'd by a Triangular File, the Blade of the Saw being firſt fix'd in a Whetting Block.

After they have been fil'd, the Teeth are ſet, that is to be turned aſkew, or out of the Right-Line, that they may make the Kerf or Fiſſure the wider, that the Back may follow the better.

This they perform by putting an Inſtrument call'd a *Saw-Wreſt*, between every other two Teeth, and giving it a little Wrench towards you, and the other a little from you.

The Teeth are always ſet ranker for coarſe, cheap Stuff, than for hard and fine, becauſe the ranker the Teeth are ſet, the more Stuff is loſt in the Kerf, and if the Stuff be hard, the greater the Labour in ſawing it.

But of all *Mechanicks* there are none have ſo many as the Joiners, nor ſo many different Kinds, as

The *Pit-ſaw*, a large two handed Saw, us'd to ſaw Timber in Pits. It is ſet rank for coarſe Stuff, ſo as to make a Kerf or Fiſſure of almoſt a quarter of an Inch; but for finer Stuff, finer.

The *Whip-ſaw*, which is alſo two handed, us'd in ſawing ſuch large Pieces of Stuff as a Hand Saw will not eaſily perform.

The *Hand-ſaw* is made for a ſingle Man's Uſe. Of theſe there are various Kinds, as the *Bow* or *Frame* Saw, furniſh'd with Cheeks; by the twiſted Cord and Tongue in the middle of it, the upper Ends are drawn

close together, and the lower set further apart.

The *Tenant-saw*, which being very thin, has a Back to keep it from bending.

The *Compass-saw*, which is very small, and its Teeth usually not set; the Use of it is to cut a round, or any other Compass Kerf; for which Purpose, the End is made broad, and the Back thin, that it may have a Compass to turn it.

SAWING, the Application of the SAW in dividing of Timber, &c. into Boards.

There are Mills for sawing of Wood, carried both by Wind and Water, which perform it with much more Expedition and Ease, then is done by the Hand.

These Mills consist of parallel Saws, which rise and fall perpendicularly by the Means of one of the grand Principles of Motion.

These require but a very few Hands, *viz.* only to push along the Timber, which are either laid on Rollers, or suspended by Ropes, in Proportion as the *Sawing* advances.

These are frequently found abroad; and were lately begun to be introduc'd into *England*, but the Parliament thought fit to prohibit them, because they would spoil the Sawyers Trade and ruin a great many Families.

M. *Felibien* in his Principles of *Architecture*, makes mention of a Kind invented by one *Missien*, Inspector of the Marble Quarries in the *Pyrenees*, by Means of which, Stones are sawn even in the Rock it self, out of which they are taken.

Some of these, he says, are 23 Foot long, made of Iron, without Teeth; but he does not describe either their Form or Application.

Sawyers most commonly work by the Hundred, that is, by the hundred Superficial Feet, for which they have various Prices, not only in different Places, but also for different Kinds of Timber, as will appear by the following Articles.

Oak; the sawing of *Oak* is in some Places 2 *s.* and 8 *d.* in others 3 *s.* in others 3 *s.* 6 *d.* the hundred.

Elm; the sawing of *Elm* is in some Places, 3 *s.* the hundred; commonly about the Price of Oak.

Ash and *Beach*. The sawing of *Ash* and *Beach* is generally worth 6 *d.* in the Hundred more than Oak or Elm. In some Places 'tis 3 *s.* in others 3 *s.* 6 *d.* in others 4 *s.* *per* Hundred.

By the Load. Sawyers sometimes work by the *Load*; *viz.* so much for cutting out a Load (or 50 Foot) of Timber; the Price of which is various, according what the Timber is cut to. But the common Price is 10 *s.* the Load for *Ship Planks*, of two Inches thick; and for Building

Timber	Large Size, 6 *s.* or 6 *s.* 6 *d.*	the Load.
	Large Size, 7 *s.*	
	Small Size, 7 *s.* 6 *d.* or 8 *s.*	

When

When *Sawyers* ſaw by the Load, they commonly agree for it as follows.

They have all their Sizes which they are to cut, ſet down; and they will cut none ſmaller, neither will they ſlab any, unleſs they are paid for it by Meaſure, over and above what they are to have by the Load.

They never cut any Thing leſs than Rafters, which are about four and five Inches, and which is generally the ſmalleſt Timber in a Frame, except Quarters and Window Stuff, which they generally cut by the Hundred.

If the Carpenter will have any Pieces clear'd by ſlabbing, after they have cut them off to their Size, they will alſo be paid by Meaſure for it.

They generally prick off their Sizes from the outward Edges, and what is left in the middle, they lay by till they can fit it to ſome other Size, when it is wanted.

A Carpenter has a great Deal of Labour in hewing off outſide Pieces, when 'tis ſaw'd by the Load.

Sawing by the Load is commonly reckon'd good Work for the Sawyer; but it waſtes a great Deal of Timber, it being hew'd away to Chucks.

The loweſt Price in *Suſſex* is 6 *s.* the Load, and if it be not cut in very large Scantlings, they will have 7 *s.* which is the common Price for ſawing a good large ſiz'd Timber Frame. But if the Timber Frame be ſmall and ſlight, they will have 7 and 6 *d.* or 8 *s. per* Load.

Of *Ship Planks*] are cut by the Load for about 10 *s.* at two Inches thickneſs.

If they are ſawn by the hundred, they have 3 *s. per* Hundred, and 2 *d.* for *Petting* of every Log.

If they have nothing allow'd for *Petting*, then they reckon ſo many Carves as there are Pieces, which is one Carve more than there really is.

They commonly cut Planks from 1 ½ Inch to 3 Inches thick; but they are never paid for breaking Work, till it comes to a two Foot Carf.

Of Compaſs Work] (as Mill Wheels, Furnace Wheels, Forge Wheels, Rafters for Compaſs Roofs, &c.) they have 2 *d. per* Foot.

Bevil Work] For ſawing of Bevil Work (as Hips and Sleepers, &c. Poſts, &c. in Bevil Frames; as alſo Poſts or Punchins in Polygonal Turrets, &c. alſo Cant Rails) they work by the Hundred; but they always reckon a Carf and a half; that is, they reckon half as many more Feet of ſawing as there is.

Furnace Bellows are cut by the Foot Lineal Meaſure, at 1 *s. per* Foot.

Forge Bellows are cut by the Foot Lineal Meaſure, at 4 *d.* or 6 *d. per* Foot.

Ground Guts are alſo cut by the Foot Lineal Meaſure, if ſmall, at 1 *d. per* Foot; but if 15 Inches deep, at 1 ½ *d.* if 18 Inches, at 2 *d. per* Foot.

The Meaſuring of Sawyers Work is generally done by the Foot Superficial Meaſure.

There is no Difficulty in taking the Dimensions, for they reckon the Depth of the Carf for the Breadth, and the Length for the Length.

The Breadth (or Depth) and Length of a Carf being taken and multiply'd together (by croſs Multiplication) gives the Area or Superficial Content of the Carf.

Having found the Number of Feet in one Carf; multiply it by the Number of Carves of the ſame Depth and Length, and ſo you have the Area of them all.

Note 1. That when they have thus caſt up their Work in Feet, they are paid for it by the Hundred [that is 100 Feet] at various Rates.

2. That if the Carf be but ſix Inches (or be leſs than ſix Inches) in Depth, they have a Cuſtom of being paid for Carf and half (as they phraſe it) that is for half ſo much more as it comes to by Meaſures.

The Reaſon they urge for this Cuſtom is, their Trouble in often Linding and removing their Timbers.

3. *That for breaking Work* [that is cutting a Log through the middle] and *Slabbing* [that is cutting off the out-ſide Pieces] if the Carf be more than 12 or 13 Inches deep, they are paid by the Foot Lineal Meaſure, at various Prices, according to the different Depth of the Carf.

Inches deep	per Foot
15	1 *d.*
18	$1\frac{1}{2}$
20	2
22	$2\frac{1}{2}$
24	3
26	$3\frac{1}{2}$
28	4
30	$4\frac{1}{2}$
32	5
34	$5\frac{1}{2}$
36	6

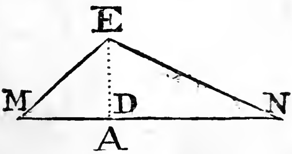
That in ſome Places 'tis the Cuſtom to allow the Sawyer but one Breaking Carf in a Log; but ſome Sawyers claim it as a Cuſtom to have *Half Breaking Work*; as if they have four deep *Curves*, then they will have two Breaking Works, and the other two hundred Work.

SCABELLUM [in the antient *Architecture*] was a kind of Pedeſtal, uſually made Square, ſometimes Polygonal, very high and ſlender, commonly ending in a ſort of Sheath or Scabbard, or profil'd in the Manner of a Balluſter. The Uſe of it is to bear *Buſto's Relievo's*, &c.

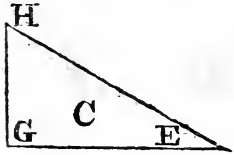
SCAFFOLD [in *Architecture*] is an Aſſemblage of Planks and Boards, ſuſtain'd by Treſſels and Pieces of Wood fixt in the Wall, upon which Maſons. Bricklayers, &c. ſtand to work in building high Walls, &c. and Plaſterers, &c. in Plaſtering Cielings, &c.

SCALE [in *Mathematicks*] ſignifies any Meaſures or Numbers which are commonly uſed; or the Degrees of any Arch of a Circle, or of ſuch right Lines as are deſcribed; from thence, ſuch as Sines, Tangents, Chords, Seconds, &c. drawn or plotted down upon a Ruler for ready Uſe and Practice in Geometrical and other Mathematical Operation.

A SCALENE *Triangle* } is
SCALENUM *Triangle* } a
Triangle whoſe 3 Sides are unequal to one another, as the Triangles C and D.

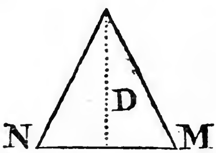


Here Note, that when one of the Angles of a Scalene Triangle is right angled, as the Triangle C, right Angle at G, then ſuch a Triangle is called a right angled plain Triangle,

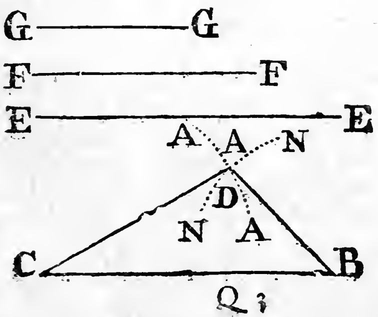


wherein the Side E G is called the Baſe; the Side H G, the Perperpendcular, and the Side E H, the Hypothenuſe.

Note alſo that in all Triangles, wherein a Line is drawn from any Angle to the oppoſite Side, and cuts the ſame at right Angles as the Line D, ſuch a Line is call'd the Perpendicular of the Triangle, and the Side on which it falls, as N M, is called the Baſe.



To deſcribe the SCALENUM *Triangle* A B C, whoſe Sides ſhall be equal to the 3 Lines given E E, F F, and G G.



First, Make B C = E E, and on C B, with the Distance F F describe the Arch A A, and on B with the Distance F F, the Arch N N, intersecting A A in D.

Secondly, Join D B and D C, and the Triangle will be compleated.

SCAMILLI *impares* [in the *ancient Architecture*] are certain Benches, Blocks or Zocco's, which serve to raise the rest of the Members of an Order, Column, Statue or the like, which was placed before the Horizon, *i. e.* beneath the Projectures of the *Stylobata Cordices* and other Saillies, and to prevent their being lost to the Eye, which may chance to be plac'd below their Level; or below the Projecture of some of the Ornaments of it.

SCANTLING [in *Carpentry*] is a Measure, Size or Standard, whereby the Dimensions, &c. of Things are to be determined.

SCAPUS [in *Architecture*] the Fust or Shaft of a Column.

SCENOGRAPHY is in Perspective a Representation of a Body on a Perspective Plane; or a Description thereof in all its Dimensions, such as it appears to the Eye.

The Ichnography of a Building, &c. represents the Plan or Ground Work of the Building; the *Orthography*, the Front or Upright of it; and the *Scenography*, the whole Building, the Front, Sides, and Height, and all.

SCHEME, is the Representation of any Geometrical Figure by Lines sensibly to the Eye.

SCHEME. See Arches.

SCIMA *reversa* is an O G, with the hollow Side downwards.

SCIMA. See *Cima*.

SCIOGRAPHY, the Profile or Section of a Building cut in Length and Breadth, to shew the Inside of it.

SCOTIA [in *Architecture*] is a Semi circular Cavity or Channel, between the Tores in the Bases of Columns; or between the Thorus and the Astragal, and sometimes 'tis put under the drip in the Cornice of the *Dorick* Order.

The *Scotia* has an Effect just opposite to that of the Quarter round.

Our Workmen frequently call it the Casement.

M. *Perrault* calls it a hollow obscure Moulding between the Tores of the Base of a Column.

It is also call'd by some the concave Member, and by others *Trochilus*, from the *Greek*, *Trochylos*, a Pulley, which it resembles as to Form.

In the *Corinthian* Base there are 2 *Scotia*, the upper of which is the Smaller. According to *Felibien*, the *Cavetto* is a fourth Part of the *Scotia*.

SCREW } SCRUE } is one of the Mechanical Powers, consisting of a Cylinder sulcated, or hollowed in a spiral Manner, and moving or turning in a Box, or Nut cut so as to answer exactly, chiefly used in Pressing or Squeezing Bodies close; but sometimes also in raising Weights.

If the furrowed Surface be convex, the Screw is said to be *Male*;

Male; if concave, 'tis *Female*.

Where Motion is to be generated, the *Male* and *Female* are always joined; that is, whenever the Screw is to be used as a simple Engine or Mechanical Power.

When it is join'd with an Axis in Peritrochio, there is no Occasion for a Female; but in that Case it becomes Part of a compound Engine.

In the Screw, the Power is to the Resistance, as the said Distance between 2 Threads to the Periphery of a Circle, run through by that Point of the Handle to which the Power is apply'd. Or,

SCREW, is a Cylinder cut into several concave Surfaces, continually inclin'd, or in plainer Terms, it is the wedge winded about the Convexity of a Cylinder, with a certain and equal Inclination, whose each Circumvolution is call'd a *Helix*, or Thread of the Screw, PO,NMLKH. See *Plate*, *Fig*. 1.

This Engine is very useful for moving or pressing with great Force.

It was from the right angled Triangle, or inclin'd Plain, that the first hint was given to the Inventors of the *Screw*, which was made by the winding the said Triangle about the Convexity of a Cylinder, as the Triangle H K I, about the Cylinder H I P Q; whereby it became of more Use, and was contain'd in less Space: for which End the Height of the Triangle has been allow'd for I K; the Height of the Cylinder, and the Inclination of the Hypothenuse of the said Triangle has been given to the *Helix* or Thread H K, and so in like Manner to all the other *Helixes* that go upwards round about the Cylinder of the Screw, which in Fact makes the Thread or Helix an actual spiral Line, wound about the Convexity of the Cylinder.

Since that the Screw is no other than the wedge, it therefore follows, that if a Power sustain a Weight by means of a Screw, that Power will be to that weight as the height of the Screw is to the Head of the Screw.

That is, if the whole Line or Thread of the Screw was unwound from the Convexity of the Cylinder, and laid at full Length;

Then the Power apply'd.

Will be to the Weight that it will Equipoise.

As the Height of the Cylinder is to the Length of the extended Thread.

Whence it is easy to conclude, that in a Screw, the Force of the Power is the greater, the nearer the Circumvolutions of the Thread are together, and the more they are inclin'd to the Horizon; because then the Height of the Cylinder is capable of containing a greater Length of the *Helix* or Thread, and consequently the *Helix* will have a greater Ratio to the Height of the Cylinder, whereby the Power will likewise have a greater Ratio to the Weight to be rais'd.

But to make an Estimate of the Force of the Screw, there is no Occasion to Measure the

whole Length of the Thread, nor the Height of the whole Cylinder; for if it be known how often the Height of one Thread from the other is contain'd in one Circumvolution or *Helix*, that is how often the Height H L is contain'd in the circuit of the *Helix* H K L, because H P, the whole Height of the Cylinder, is contain'd just as many times in the whole Thread of the Screw H K L M N O P, and therefore the Force is the same. See *Pl. f.* 1.

Hence 'tis plain that the Screw can raise a Weight by one *Helix* or Thread, no higher than from H to L, and that if the Height H L is contain'd ten times in the Helix H K L; a heavy Body will by Means of this Engine be sustain'd by a Power little more than equal to $\frac{1}{10}$ Part of its Weight.

This Engine is always work'd with a Lever of the second Kind (as the preceeding Figure) as A C, whose *Fulcrum* is the Centre of the Cylinder A: Distance of Weight = the Radius of the Cylinder and Power at C, &c. and as has been before prov'd, that the further the Power is applied from the *Fulcrum* of a Lever, the greater is its Force; so it is plain, that by increasing the Length of the *Lever*, the Force may be also increas'd at Pleasure; but then what is here gain'd in Force, will be lost in Space, as has been already prov'd in all the preceeding Engines. *f.* 2.

SCRIBING [in *Joinery* &c.] is a Term us'd when one Side of a Piece of Stuff is to be fitted to the Side of some other, which last is not regular: Therefore to make these two Pieces join close together all the Way, they *scribe* it thus; they lay the Piece of Stuff they intend to *scribe*, close against the other Piece of Stuff they intend to *scribe* to, and open their Compasses to the widest Distance, these two Pieces of Stuff bear off each other; then the Compasses (moving stiff in their Joint) they bear the Point of one of the Shanks against the Side they intend to *scribe* to, and with the Point of the other Shank they draw a Line on the Stuff they intend to be *scrib'd*.

Thus have they a Line on the irregular Piece, parallel to the Edge of the regular one; and if the Stuff be wrought away exactly to the Line when these Pieces are put together, they seem a Joint.

SCROWLS [in *Architecture*] See *Volute*.

SCULPTURE, is the Art of Cutting or Carving in Wood, Stone or other Matter, to form various Figures for Representations: Sculpture in its Latitude, includes both the Art of working in *Creux*, properly call'd *Engraving*, and of working in *Relievo*, which is what in Strictness is call'd Sculpture.

It is also us'd to signify the fashioning of Wax, Earth, Plaister, &c. to serve as Models or Moulds, for the casting of Figures of Metals in.

SCUPPER *Nails*. See *Nails*.

SEASONING of TIMBER is the preparing of Timber for

Uſe: the *Timber* being fell'd, &c. muſt be laid up very dry in an airy Place, yet out of the Wind or Sun; others ſay it ought to be free from the Extremities of the Sun, Wind and Rain; and that it may not cleave but dry equally, you may dawb it over with Cow Dung; let it not ſtand upright, but lie along one Piece upon another, interpoſing ſome ſhort Blocks between them, to preſerve them from a certain Mouldineſs, which they uſually contract while they ſweat, and that often produces a kind of *Fungus*, eſpecially if there are any ſappy Parts remaining.

Some again keep their *Timber* as moiſt as can be, by ſubmerging it in Water, to prevent its cleaving; and this is good in Fir and other Timber too, both for the better Stripping and Seaſoning.

When the Boards therefore have lain a Fortnight in Water, they muſt be ſet upright in the Sun and Wind, ſo as it may freely paſs through them, eſpecially during the Summer Heats, which is the Time of finiſhing Buildings, and turn'd daily; and thus even new ſawn Boards will floor much better than thoſe of a many Years dry Seaſoning.

But to prevent all poſſible Accidents, when Floors are laid, let the Joints be ſhot, fitted and tack'd down for the firſt Year, nailing them for good and all the next; whereby they will lie ſtanch cloſe, and without ſhrinking in the leaſt; as if they were all of one Piece.

Water Seaſoning among *Wheelwrights*, is of ſpecial Regard: As for the Elm, tho' the Tree be fell'd never ſo green, for ſudden Uſe, if plunged four or five times in Water, eſpecially Salt, which is beſt, it obtains an admirable Seaſoning, and may be immediately us'd.

Beſides which Method, ſome again commend burying in the Earth; others, in Wheat; and there are alſo Seaſonings of the Fire, as for the ſcorching and hardening of Piles, which are either to ſtand in Water, or the Earth: Sir *Hugh Plat* informs us, that the *Venetians* us'd to burn and ſcorch their *Timber* in a flaming Fire, continually turning it round with an Engine, till they have got upon it a hard, black, coaly, Cruſt, whereby the Wood is brought to ſuch a hardneſs and dryneſs, that neither Earth nor Water can penetrate it.

Mr. *Evelyn* ſays he had ſeen Charcoal dug out of the Ground, amongſt the Ruins of the ancient Buildings, which in all Probability had lain cover'd with Earth above 1500 Years.

As for *Poſts*, and the like that ſtand in the Ground, the burning the outſides of the Ends that are to ſtand in the Ground to a Coal, is a great Preſervative of them, and ſome have practis'd the burning the Ends of *Poſts* for *Railing* and *Paleing*, with good Succeſs.

It likewiſe appears by the Abſtract of a Letter written by *David Vonderbeck*, a *German* Philoſopher and Phyſician, at

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Minden, to Dr. *Largelot*, in the Philoſophical Tranſactions, that the ſame is practiced in *Germany*. The Words are as follows.

Hence alſo we ſlightly burn the Ends of Timber *to be ſet in the Ground, that ſo by the Fuſion made by the Fire, the volatile Salt, which by Acceſſion of the Moiſture of the Earth would eaſily be conſum'd to the Corruption of the* Timber, *may catch and fix one another.*

SECANT, is a Line drawn from the Centre of a Circle, cutting it and meeting with the Tangent without.

SECTION [in the *Mathematicks*] ſignifies the cutting of one Plane by another; or a Solid by a Plane.

SECTION of a Building [in *Architecture*] is underſtood of the Profile and Delineation of its Heights and Depths, rais'd on a Plane, as if the Fabrick were cut aſunder to diſcover the Inſide.

SELLS [in *Architecture*] are of two Kinds, *viz. Ground Sells* [which are the loweſt Pieces of Timber in a Timber Building, on which the whole Superſtructure is erected] and *Window Sells* (ſometimes call'd Window Soils) which are the Bottom Pieces in a Window-Frame.

The *Price of putting* in Ground Sells in a Houſe, is commonly rated at 3*d.* or 4*d.* a Foot, for Workmanſhip only.

SERPENTINE *Line*; the ſame with *Spiral*.

SESQUITERTIONAL *Proporional*, is when any Number or Quantity contains another once and one third.

SETTING. See *Pitching*.

SETTING *of Fronts*. See *Fronts*.

SEWERS [in *Architecture*] are Shores, Conduits, or Conveyances for the Suillage and Filth of an Houſe.

Sir *Henry Wootton* adviſes that Art imitate Nature in theſe ignoble Conveyances, and ſeparate them from Sight (where there wants a running Water) into the moſt remote, loweſt and thickeſt Part of the Foundation, with ſecret Vents paſſing up through the Walls to the wide Air, like Tunnels; which all the *Italian* Architects commend for the Diſcharge of Vapours, though elſewhere but little practiſed.

SEXANGLE [in *Geometry*] is a Figure conſiſting of ſix Angles.

SHADOW [in *Opticks*] is a Privation of Light, by the Interpoſition of an opake Body; but as nothing is ſeen but by Light, a mere Shadow is inviſible; therefore when we ſay we ſee a Shadow, 'tis partly that we ſee Bodies plac'd in the Shadow, and illuminated by Light, reflected from collateral Bodies; and partly that we ſee the Confines of Light.

If the opake Body which projects the Shadow, be perpendicular to the Horizon, and the Place 'tis projected on be horizontal, the Shadow is called a *Right Shadow*: Such are the Shadows of Men, Trees, Buildings, &c.

If

If the Opake Body be plac'd parallel to the Horizon, the Shadow is call'd a *versed Shadow*, as the Arms of a Man ſtretch'd out.

Laws of the Projection of SHADOWS *from Opake Bodies.*

1. Every opake Body projects a *Shadow* in the ſame Direction with its Rays; that is, towards the Part oppoſite to the Light. Hence as either the Luminary or the Body changes Place, the Shadow likewiſe changes.

2. Every opake Body projects as many Shadows as there are Luminaries to enlighten it.

3. As the Light of the Luminary be more intenſe, the Shadow is the deeper. Hence the Intenſity of the Shadow is meaſured by the Degrees of Light that Space is derived from.

4. If a luminous Sphere be equal to an opake one, it illumines; the Shadow this latter projects, will be a Cylinder; and of Conſequence, will be propagated ſtill equal to it ſelf, to whatever Diſtance the Luminary is capable of acting: ſo that if it be cut in any Place, the Plane of the Section will be a Circle equal to the great Circle of the opake Sphere.

5. If the luminous Body be greater than the opake one, the Shadow will be conical. If therefore the Shadow be cut by a Plane parallel to the Baſe, the Plane of the Section will be a Circle, and that ſo much the leſs, as it is at a greater Diſtance from the Baſe.

6. If the luminous Sphere be leſs than the opake one, the Shadow will be a truncated Cone, and of Conſequence it grows ſtill wider and wider, and therefore if cut by a plane Parallel to the Section, that Plane will be a Circle ſo much the greater, as 'tis farther from the Baſe.

SHAFT [in *Architecture*] as the *Shaft of a Column*, is the Body of it, thus call'd from its ſtraitneſs; but is more frequently call'd by Architects the Fuſt.

Shaft is alſo us'd for the Spire of a Church Steeple.

The *Shaft* of the *Tuſcan* Column, ſays M. *Le Clerc*, always terminates at the Top with an Aſtragal, and at Bottom with a Fillet, which in this Place is call'd *Orla*.

The Shaft uſually diminiſhes in Thickneſs towards the Top; and this Diminution commences from a third Part of its Height; that is to ſay, the Height of the Shaft being divided into three equal Parts, the firſt of them is equal or cylindrical, and the two others diminiſh imperceptibly to the Aſtragal, where the Diminution terminates.

Some give a little Swelling to their Columns; that is, they make the Shaft ſomewhat bigger towards the Top of the firſt third of its Height, than towards the Bottom; or rather they diminiſh the Bottom of the Shaft, and by this Means make the upper Part of the firſt Diviſion appear to ſwell.

But this Diminution at the

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Bottom of the Shaft ought never to exceed one Minute or one Minute and a half at the utmoſt. The Truth is, there ought to be no Swelling at all in a Column, excepting where there is ſome particular Reaſon for it; as where the Orders are plac'd over one another.

Some very conſiderable Architects, on Occaſion encompaſs the Shafts of their Columns with ſeveral Cinctures or Fillets imboſs'd. But theſe Kind of *Ruſtick* Ornaments, ſays M. *Le Clerc*, are never to be imitated, excepting in the Gates of Citadels, or Priſons, in Order to render their Entrance more frightful and diſagreeable.

This too muſt be obſerv'd, that if theſe *Ruſtick* Ornaments may be admitted any where, 'tis only in *Tuſcan* Columns, or at moſt in *Doric*; and never in the other more delicate Orders, eſpecially where they are fluted.

SHAKY } [with *Builders*]
SHAKEN } ſuch Stuff as is crack'd either with the Heat of the Sun, or the Drought of the Wind.

SHARD NAIL. See *Nails*.

SHEATHING NAILS. See *Nails*.

SHEET LEAD. See *Lead*.

SHIDES } [in *Building*]
SHINGLES } are ſmall Pieces of Wood or quarter'd oaken Boards, ſawn to a certain Scantling, or more uſually cleft to about an Inch thick at one End, and made like Wedges four or five Inches broad, and eight or nine Inches long.

They are us'd in Covering, more eſpecially Churches and Steeples, inſtead of Tiles or Slates.

This Covering is dear, yet where Tiles are very ſcarce, and a light Covering requir'd, is preferable to Thatch, if made of good Oak, and cleft, not ſawed, and then well ſeaſon'd in Water and the Sun, they make a ſure, light and durable Covering: The Building is firſt to be covered all over with Boards, and the Shingles nail'd thereon.

The *Price of Shingles* are ſometimes 20 *s. per* Thouſand, but theſe are bad Ware; if they are good, they are worth 30 *s. per* Thouſand; and 40 *s.* a Thouſand have at ſometimes been given for Shingles to lay on Steeples; for thoſe that lie on high, and hang ſo Perpendicularly, ought to be of the beſt Sort.

The common Price of cleaving and making of Shingles, is 10 *s. per* Thouſand.

A Tun of Timber will make about 3000 Shingles.

Of *Laying on Shingles*] In Order for Covering with Shingles, the Building muſt be firſt covered with Boards, which being done, the Shingles are faſtened to thoſe Boards, with 4 *d.* 5 *d.* or 6 *d.* Nails, in every Courſe at a certain Gage, *viz.* at 3½ Inches or 4 Inches from under one another; for they commonly make three Waters (as they phraſe it) that is, they uſually hang three Shingles in Height, in the Length of one; ſo that if the Shingles

Shingles are 12 Inches long, they are laid at four Inches Gage.

In Breaking Joint they do not obſerve to make one Joint over the middle of another; but they ſometimes break Joint an Inch, an Inch or a half, or two Inches, according to the Breadth of the Shingles, for they (eſpecially if they are cleft) are not exactly of a Size.

As *for the Price of laying on Shingles.*] For laying them on Spire Steeples, where the Work is high and troubleſome, they have uſually 20*s.* a Thouſand, but for lower Work (as upon Houſes and the like) they will both cleave, make and lay them on for the ſame Price, or if they only lay them on, they will do it for 10*s. per* Thouſand.

For dreſſing old Shingles, [that is for hewing them and cutting off the ragged lower Ends] they have about 6*s. per* Thouſand.

As to the *Number of Shingles* that will cover a Square, 81 Shingles of four Inches broad, and laid at four Inch Gage, will cover a Yard ſquare, and conſequently 900 will cover a Square (or 100 Superficial Feet) of Healing; but it is uſual to allow 1000 to a Square, becauſe the Shingles ſeldom hold out to be all four Inches ſquare, and to a 1000 Shingles, they allow a 1000 Nails.

SHINGLING the Covering with Shingles.

SHINLOG. See *Bricks*.

SHIP-WRIGHT. How to draw a Ship-Wrights Arch, by the Interſection of Right-Lines.

Firſt, Draw the Baſe Line A B, and erect the perpendicular Lines A C and B D, the Heights of which anſwer to the Rake of the Arch or Ceiling of the Cabin, and draw the Line C D, and divide it in the middle at E; then divide A C into any Number of equal Parts, and C E into the ſame Number of Parts; alſo B D into any Number of equal Parts, and D E into the ſame; then draw Right Lines into each correſpondent Diviſions which will create the Arch A E B, which was required. See *Plate*, *Fig.* 3.

SCHOFEET. To draw the two different Edges of a twiſted Schofeet.

The Figure 4 in the Plate, repreſents the inward and outward Edges of a twiſted Schofeet of a Semi-Circular Window, whoſe Jaumbs ſplay more or leſs, and whoſe Crown lies level without ſplaying; the Arch C G D is the Edge next the Head of the Window, and the Arch A G B is the Edge next the Room: The Queſtion is, to draw the inward Arch A G B, ſo that it ſhall diminiſh gradually from nothing at the Crown G, to the Splays of the Jaumbs, at the Springing A C and D B.

Firſt, Draw the Baſe Line A B, equal to the Width of the Window and Splays of both Jaumbs, and divide it in the middle at H, then ſet on the Splays from A to C, and from B to D.

When you have done this, take

take H C or H D in your Compaſſes, and ſet one Foot in H, and with the other ſtrike the Arch C G D.

Erect the dotted Lines C E D F, equal to H G, and perpendicular to A B, and draw the Line E F, alſo the Lines A E and B F, into any Number of equal Parts; alſo E G and G F, and draw Right Lines to their correſpondent Diviſions, and they will form the Arch A G B, which will ſplay gradually from nothing at G to A C and D B, which is the Queſtion requir'd.

SHOP WINDOWS, theſe may be afforded to be done at the ſame Rate as batten'd Doors, beſides the Iron Work, as Bolts, Staples, Hinges, Locks, Keys, Latches, Chains, *&c.*

SHREADINGS, the ſame as *Furrings*.

SILERY, the ſame as *Cilery*.

SIZE for Gilding both with Silver and Gold.

For Gold *Size*, take yellow Oaker and grind it on a Stone with Water, till it be very fine, and afterwards lay it on a Chalk Stone to dry; this is the common Way; or you may waſh it, as is taught in the Article WASHING of Colours; for when 'tis waſh'd, to be ſure nothing but the pureſt of the Colour will be us'd, and beſides it is done with leſs daubing.

When the Oaker has been thus prepar'd, grind it as you do other Oil Colours, only with fat drying Oil; but it is ſomething more laborious Work, in that it muſt be ground very fine, even as Oil it ſelf; for the finer it is, the greater Luſtre the Gold will carry that is laid on it.

Here *Note*, that you muſt give it ſuch a Quantity of your fat Oil, that it may not be ſo weak as to run, when you have laid it on; nor ſo ſtiff that it may not work well; but of ſuch a competent Body, that after it is laid on, it may ſettle itſelf ſmooth and gloſſy; which is a chief Property of Size.

Silver *Size* is made by grinding White Lead with fat drying Oil, ſome adding a very ſmall Quantity of Verdigreaſe to make it bind.

SKEWBACK. See *Arches*.

SKIRTING BOARDS, the narrow Boards that are fitted round the underſide of Wainſcot, againſt the Floor.

SKREEN, an Inſtrument us'd by Labourers in ſifting Earth for making Mortar.

SLABS, the outſide ſappy Planks or Boards that are ſawn off from the Sides of a Timber Tree.

SLATE, a blue foſſil Stone very ſoft when dug out of the Quarry, and therefore very eaſily cut or ſawn into long thin Squares or Eſcallops, to ſerve inſtead of Tiles for the Covering of Houſes. The Ancients were not acquainted with the Uſe of Slate, and inſtead of them cover'd their Houſes with Shingles.

Beſides blue Slate, we have in *England* a greyiſh Slate, which is alſo call'd *Horſham* Stone, becauſe the greater Quantities of it, are found about *Horſham* in *Suſſex*.

The

The *blue Slate* is a very light, beautiful and laſting Covering; but then it is pretty dear, becauſe the Roof muſt be firſt boarded over, and the Slates hung on Tacks, and laid with finer Mortar than Tiles.

The *grey Slate* is chiefly us'd in covering Churches, Chappels, Chancels, *&c.*

The Covering with this Sort of Slate, is dearer than Tiles; becauſe the Timber of the Roof muſt be very ſtrong for them, it being almoſt double the Weight of Tiles.

Mr. *Colepreſs* directs, that in Order to judge of the Goodneſs of Slate, to knock it againſt any hard Body, to make it yield a Sound; and ſays, if the Sound be good and clear, the Stone is firm and good; otherwiſe its crazy,

Another Way of proving the Goodneſs of Slate, is firſt to weigh it exactly, and then to lay it 6 or 8 Hours under Water, and then wipe it dry and weigh it again, and if it weighs more than it did before, 'tis a Sign that it is of that kind, that ſoaks in Water, and therefore will not laſt long without rotting the Timber or Lath.

There is alſo another Way of proving it, by placing a Slate half a Day perpendicularly in a Veſſel of Water, ſo as to reach a conſiderable Height above the Level of it: And if the Slate be firm and cloſe, it will not draw Water, that is the Water will not have aſcended above half an Inch above the Level of that in the Veſſel, nor that, perhaps any where but at the Edges, the Texture of which might probably be looſened by hewing; but if the Stone be bad, it will have drawn Water to the very Top, be it as high as it will. There are Slates in ſeveral Places, which the moſt experienced *Slaters*, or Coverers conjecture to have continued ſeveral hundred Years, and are ſtill as firm as if firſt put up.

The *Blue Slate* cut into long Squares, or Eſcallops, makes a very handſome Appearance, and is commonly uſed in covering of Summer or Banqueting Houſes in Gardens; it being a very light and laſting Covering.

But if theſe Slates be rudely cut, and careleſly laid (in Reſpect of Form) it is then accounted a cheaper Covering than with Plain Tiles, eſpecially in thoſe Countries where the Country affords Plenty of them.

As *to the Price of Slating*, it is valued at about 6 *d.* the Yard Square, or by the Square of 10 Foot (that is 100 Foot) from 30 *s.* to 3 Pounds or more in ſome Places.

As to the *Price* of *pointing Slates*, Mr. *Wing* ſays it is worth about 1 *s.* or 13 *d. per* Square for hewing and making them fit for the Work.

As *to the Price of Slates*, Mr. *Wing* ſays they, are worth at the Pit 12 or 14 *s. per* Thouſand, which will nearly do 36 ſquare Yards.

Of *Meaſuring Slating*. It is meaſured in ſome Places by the Rod of 18 Foot Square, which contains 324 ſuperficial Feet, or 36 Yards.

In

In the Measuring of this Sort of Work, where there are Gutters or Valleys, there is commonly an Allowance, which is to take the Length of the Roof, all along upon the Ridge which makes the Gutters double Measure, as much more as really it is; which is allow'd in some Places, but not in others; and so depends upon the Custom of the Place.

SLEDGE, a kind of Machine or Carriage, without Wheels, for the Conveyance of very weighty Things, as huge Stones, *&c.*

The *Dutch* have a Sort of Sledge upon which they can carry any Burthen by Land. It consists of a Plank a Foot and half Broad, and the Length of the Keel of a moderate Ship, raised a little behind and hollow in the Middle, so that the Sides go a little aslope, and are furnished with Holes to receive Pins; the Rest is quite even.

SLEEPER [in *Architecture*] is the oblique Rafter that lies in a Gutter. See *Hip.* N. 1.

SLIPPER, the same as *Plinth*.

SLUICE, a Vent or Drain for Water.

SLUICE, a Frame of Timber, Stone, or any other Matter serving to retain and raise the Water of a River, *&c.* and on Occasion to let it pass: As the Sluice of a Mill, which stops and collects the Water of a Rivulet, *&c.* to let it fall at Length in the greater Plenty upon the Mill-Wheel; such, are those used as Vents and Drains to discharge Water off Land; and such are the Sluices in *Flanders*, &c. which serve to prevent the Water of the Sea from Overflowing the lower Lands, except when there is Occasion to drown them.

Sometimes there is a kind of Canal inclosed between 2 Gates or Sluices, in artificial Navigation, to save the Water, and render the Passage of Boats equally Easy and Safe upwards and downwards; as in the Sluices of *Briare* in *France*, which are a sort of massive Walls Built parallel to each other, at the Distance of 20 or 24 Feet, closed with strong Gates at each End, between which is a kind of Canal or Chamber considerably longer than broad, wherein a Vesiel being inclosed, is let out at the first Gate, by which the Vessel is raised 15 or 16 Foot, and passed out of the Canal into another much higher.

By such Means a Boat is convey'd out of the *Louure* into the *Seyne*, tho' the Ground between them be rais'd obove 150 Feet higher than either of those Rivers.

SMALT, is a lovely Blue, if it lie at a Distance, but it must be only strew'd on upon a Grourd of white Lead, for it so Sandy that it carries no good Body in Oil; and besides Oil changes the Colour of it, and make it look quite Black, except Whites be mix'd with it, and they spoil the Beauty of the Colour, and make it faint; therefore the best Way to lay it on, is by *Strewing*, and then there is not a more glorious Colour in the World.

The

The Manner of ſtrewing Smalt.

Firſt, Temper up white Lead pretty ſtiff, with good clear drying Oil; let it be as ſtiff as it well can be to ſpend well from the Pencil; cover over the Superficies of the Work that you intend to ſtrew Smalt upon with this white Colour, and if it be the Margin of a Dial, whoſe Figures are already gilt with Gold, let every Part between the Figures, and where there is no Gold laid on, be done over, and be very exact in the Work; for the Smalt takes no where but on this new and moiſt Ground.

Lay the Work that is to be done over with ſtrew'd Smalt flat, and ſtrew it thin on the Thing to be coloured, and ſtroke over it with the Feather edge of a Gooſe Quill, that it may lie even and alike thick in all Places: when this has been done, dab it down cloſe with a bunch of ſoft pliable Linen-cloth, that it may take well upon the Ground to be thoroughly dry; then wipe off the looſe Colour with a Feather, and blow the Remainder of it off with a pair of Bellows, and the Work is finiſh'd.

This is the Method for Colouring any kind of Work with Smalt by ſtrewing, provided the Work be ſuch as requires only the plain Colour.

But in Caſe you are to Paint any kind of Body with Smalt, which requires Shadow for the more perfect Reſemblance; as ſuppoſe it to be a blue Bell or a blue Boar, *&c.* in this Caſe, when you have drawn out the perfect Symmetry of the Shape you intend, and have covered it with a Ground of white Lead, well and ſtiffly tempered with clear and fat Linſeed Oil, then give it the neceſſary Shadows with good black well tempered; and when you have finiſh'd theſe Shadows, afterwards ſtrew on the *Smalt* as before directed; and when the whole is dry, and the ſuperfluous Part be taken away, the Work will appear with all its Shadows, as exact as poſſible.

Note, That the Work upon which you lay on this Ground, that is to be ſtrew'd with Smalt, ought to be firſt ſufficiently prim'd, and laid alſo over once with White, before the Ground is laid on, that you may be ſure that the Ground is perfectly White; for a white Ground is the only thing that gives the Beauty and Glory to the Colour of the Smalt.

In all other Caſes where the Work to be ſtrew'd over with Smalt does not lie flat, you muſt take your Smalt upon a flat Bunch of Linnen-cloth, and ſo dab it upon the Ground you are to lay it upon.

Note, That there are 2 Sorts of Smalt, the one much finer than the other; but the coarſeſt gives the moſt glorious Colour of all, if look't on at a Diſtance; for near the Eye the Beauty is not ſo great; the fineſt is that which is call'd *Oil Smalt*, which is ground with white Lead, and may be laid in Oil; but does not bear a good Body, nor does it work but with much Difficulty.

SMITHS *Work* [in Relation to *Architecture*] is of divers Kinds, as making Casements, Pallisade Work in Gates or otherwise, Dogs, Bars, large Hooks, Hinges, Staples, *&c.* for which they have in some Places 3 ½ *d*, in others 4 *d. per* Pound; but for small and neat Hooks, Hinges, Staples, *&c.* they have from 4*d* to 8*d per* Pound. For Iron Balconies, 5*d per* Pound.

Of *making a Smith's* Bill. This should be done after the following Manner.

Mr. *Thomas Anderson*, his Bill of Materials had of, and Work done by *John Smith*; 1733.

	l.	s.	d.
Jan. 16. For 4 large Casements, weighing 40 *l.* at 6 *d. per l.*	1	00	00
Feb. 6. For 5 small Casements, weighing 30 *l.* at 6 *d. per l.*	0	15	00
------12. For 12 Pair of Hooks and Riders for Doors, weighing 65 *l.* at 4 *d. per l.*	1	01	08
March 17. For three great Bars for Chimneys, weighing 60 *l.* at 4 *d. per l.*	1	00	00
April 14. For 4 Door Bars, weighing 40 *l.*, at 4 *d. per l.*	0	13	04
------ 25. For 4 Dogs, weighing 24 *l.* at 4 *d. per l.*	0	08	00
May 12. For 4 large Bolts, for Doors, weighing 6 *l.* at 4 *d. per l.*	0	02	00
	5	00	00

SOCLE } [in *Architecture*]
ZOCLE } a flat square Member under the Bases of Pedestals of Statues, Vases, *&c.* which it serves as a Foot or Stand.

SOFFIT } [in *Architec-*
SOFFITO } *ture*] is any Plafond or Ceiling form'd of cross Beams or flying Cornices, the square Compartiments or Pannels of which are inriched with Sculpture, Painting or Gilding. As those are which are to be seen in the Palaces of *Italy*, in the Apartments of *Luxembourg* at *Paris*, &c.

The Sofites of Arches, says a modern Author, if they are divided into Pannels, they must be of an uneven Number, by having a Pannel in the Middle. The Border must be no more than one Sixth, nor less than one Seventh of the whole Breadth.

SOFFIT } is particularly
SOFFITO } used for the under Side or Face of an Architrave; and for that of the *Corona* or *Larmier*, which we call Plafond, and the ancient *Roman* Architects, *Lacunar*.

It is inrich'd with Compartiments of Roses; and has 18 Drops in the *Dorick* Order, disposed in 3 Ranks, 6 in each, placed to the Right Hand of the Guttæ, and at the Bottom of the Triglyphs.

SOILS. See SELLS.

SOLDER } [in *Architec-*
SODDER } *ture*] is a metallick or mineral Compoſition, uſed in Soldering or Joining together other Metals.

Solders are made of Gold, Silver, Tin, Copper, Glaſs of Tin and Lead; and it is to be obſerved, that in the Compoſition, there muſt be ſome of the Metal to be ſoldered.

There are ſeveral kinds of Solder, but that which more immediately relates to our preſent Buſineſs, is Solder for Lead, uſed by Plumbers.

This is made of two Pounds of Lead to one of Tin: but for *Glaziers* Uſe it may be made ſomething finer.

As to the Price. Solder is ſold from 8 *d.* to 10 *d.* a Pound, according to its Fineneſs.

The Goodneſs of Solder is tried by Melting it, and pouring the Bigneſs of a Crown-piece upon a Table; for if good, there will ariſe little bright ſhining Stars therein.

To know if Solder be fine enough for *Glazier*'s Uſe: Some direct to take a Piece of it and bend it to and fro near their Ear; for if it be of a fit Temper, it will crackle like Nits.

SOLID [in *Geometry*] is the third Species of Magnitude, having three Dimenſions, *viz.* Length, Breadth, and Thickneſs, and is frequently uſed in the ſame Senſe with Body.

It may be conceiv'd to be form'd by the direct Motion, or Revolution of any Superficies, of what Nature or Figure ſoever.

A Solid is terminated or contain'd under one or more Planes and Surfaces; as a Surface is under one or more Lines.

Regular SOLIDS, are thoſe terminated by Regular and equal Planes: under this Claſs come the *Tetrahedron*, *Hexahedron* or *Cube*, *Octahedron*, *Dodecahedron*, *Icoſihedron*.

Irregular SOLIDS are all ſuch as do not come under the Definition of *Regular Solids*; ſuch are the *Sphere*, *Cylinder*, *Cone*, *Parallelogram*, *Priſm*, *Parallelopiped*, &c.

SOLID *Angle*, is an Angle made by the meeting of three or more Planes, and thoſe joining in a Point, like the Point of a Diamond well cut.

SOLID *Numbers*, are thoſe which ariſe from the Multiplication of a Plane Number by any other whatſoever, as 18 is a Solid Number made by 6, (which is Plane) multiply'd by 3; or of 9, multiply'd by 2.

SOLID *Problem* [in *Mathematicks*] is one which cannot be Geometrically ſolv'd, but by the Interſection of a Circle and a Conick Section; or by the Interſection of two other Conic Sections beſides the Circle.

SOLIDITY, is a Quality of a natural Body, contrary to Fluidity, and appears to conſiſt in the Parts of the Bodies being interwoven and entangled one with another, ſo that they cannot diffuſe themſelves ſeveral Ways, as Fluid Bodies can. Or it is the Quantity of Space contain'd in a Solid Body; call'd alſo the *Solid Content* and the Cube thereof.

SOLIDITY [in *Architecture*] is apply'd both to the Consistence of the Ground, wherein the Foundation of a Building is laid, and to a Massive in Masonry of extraordinary Thickness, without any Cavity within.

SOLIVE [in *Carpentry*] signifies a Joist or Rafter, or Piece of Wood, either slit or saw'd, wherewith the Builders lay their Ceilings.

These are made of different Thicknesses, according as their Lengths require, and their Distances from each other, are usually equal to their Depths.

SOLUTION [in *Geometry*, &c.] is the answering of any Question, or the Resolution of any Problem.

SOMMERING. See *Arches*.

SPHERE [in *Geometry*] a Solid Body contain'd under one single Surface, and having a Point in the middle, call'd the Centre, whence all the Lines drawn to the Centre are equal.

The Sphere is suppos'd to be generated by the Revolution of a Semi-circle about its Diameter, which is also call'd the *Axis of the Sphere*; and the Extreme Points of the Axis, the *Poles of the Sphere*.

The Properties of the Sphere.

1. A Sphere is equal to a Pyramid, whose Base is equal to the Surface, and its Height to the Radius of the Sphere.

Hence a Sphere being esteem'd such a Pyramid, its Cube or Solid Content is found like that of a Pyramid.

2. A Sphere is to a Cylinder, standing on an equal Basis, and of the same Height as 2 to 3. Hence also may the Cube or Content of the Sphere be found.

3. The Cube of the Diameter of a Sphere, is to the Solid Content of the Sphere, nearly as 300 to 157: and thus also may the Content of the Sphere be measured.

4. The Surface of a Sphere is Quadruple to that of a Circle describ'd with the Radius of a Sphere. For since a Sphere is equal to a Pyramid, whose Base is the Surface, and its Altitude the Radius of the Sphere: the Surface of the Sphere is had, by dividing its Solidity, by a third Part of its Semi-Diameter.

If now the Diameter of the Circle be 100, the Area will be 7850; consequently the Solidity 1570000, which divided by a third of the Semi Diameter 100, the Quotient will be the Surface of the Sphere, 31400; which is manifestly the Quadruple the Area of the Circle.

The Diameter of a SPHERE being given, to find its Surface and Solidity;

Find the Periphery of the Circle, describ'd by the Radius of the Sphere.

Multiply (this being found) into the Diameter; the Product is the Surface of the Sphere: Multiply the Surface by the sixth Part of the Diameter, and the Product will be the Solidity of the Sphere.

Thus supposing the Diameter of the Sphere, 56, the Periphery

riphery will be found 175; which multiply'd by the Diameter, the Product 9800 is the Surface of the Sphere, which multiply'd by one sixth Part of the Diameter, gives the Solidity 919057, or thus;

Find the Cube of the Diameter 175616: then to 300157, and the Cube found, find a fourth Proportional 919057, and this will be the Solidity of the Sphere.

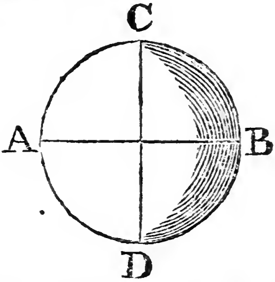
Or thus,

1. Multiply the Axis or Diameter into the Circumference, and the Product will be the Superficial Content; which multiply by the sixth Part of the Axis, and the Product will be the Solidity.

2. Or thus,: as 21 is to 11; so is the Cube of the Axis to the Solid Content.

3. Or as 1. is to .5236, so is the Cube of the Axis to the solid Content.

Example. Let A B C D be a Globe, whose Axis is 20 Inches, then the Circumference will be 62.832: then by the first Rule multiply the Circumference by the Axis, and the Product will be 1256.64, which is the Superficial Content in Inches: take a sixth Part thereof, which is 209.44 (because an exact sixth Part of 20 cannot be taken) multiply that sixth Part by 20 (the Axis) and the Product will be 4188.8 the Solidity in Inches.



Or if you multiply the Superficial Content by the Axis, and take a sixth Part of the Product, the Answer will be the same.

Or thus by the second Rule.

The Cube of the Axis is 8000, which multiply'd by 11, the Product will be 88000, which being divided by 21, the Quotient will be 4190.47, the Solidity.

Or by the third Rule.

If the Cube of the Axis be multiply'd by 5236, the Product will be 4188.8, the Solidity, the same as by the first Way. If you divide 4188.8 by 1728, the Quotient will be 2.424 Feet. See the Work,

62.832
20

6)1256.640 the Superficial Content.

209.44 a sixth Part.
20

4188.80 the Solidity in Inches,

21 : 11 :: 8000
11

21)88000(4190.47 the Content.

40
190
100
160

13

1 : .5236 :: 8000
8000

1728)4188.8000(2.424 Feet, the Solidity.

Note, If the Axis of a Globe be 1. the Solidity will be .5236; and if the Circumference be 1. the Solidity will be .016887.

By Scale and Compasses.

Extend the Compasses from 1 to 20 (the Axis) that Extent (turn'd three times over from .5236) will at last fall upon 4188.8 the Solid Content in Inches: or extend the Compasses from 1728 to 8000 (the Cube of the Axis) and that Extent will reach from .5236 to 2.424, the Solid Content in Feet.

Extend the Compasses from 1 to 20 (the Axis) and that Extent (turn'd twice over from 3.1416) will at last fall upon 1256.64, the Superficial Content in Inches; or extend the Compasses from 144 to 400 (the Square of the Axis) and that Extent will reach from 3.1416 to 8.72, the Superficial Content in Feet.

Demonstration.

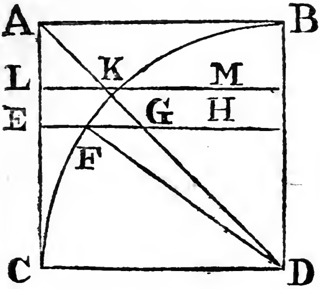
Every Sphere is equal to a Cone, whose perpendicular Axis is the Radius of the Sphere, and its Base a Plane equal to all the Surface of it.

For you may conceive the *Sphere* to consist of an infinite Number of Cones, whose Bases taken all together, compose the Surface, and whose Vertexes meet all together in the Centre of the *Sphere*: Hence the Solidity of the Sphere will be gain'd by multiplying its Surface by $\frac{1}{3}$ of its Radius.

Let the Square A B C D, the Quadrant C B D, and the Right angled Triangle A B D be suppos'd all three to revolve round the Line B D, as an Axis; then will the Square generate a Cylinder; the Quadrant an Hemisphere, and the Triangle a Cone, all of the same Base and Altitude.

Then the Square of E H (= $\square$ F D) = $\square$ F H + $\square$

□ D H (but D H = G H) and since Circles are as the Squares of their Diameters. (by *Euclid* 12. 2.) the Circle made by the Revolution of E H, must be equal to both the Circles made by the Motion of F H, and G H.



If you take the Circle made by the Revolution of F H from both, there will remain the Circle made by the Motion of G H, equal to the Ring describ'd by the Motion of E F, and thus it will always be, wherever you draw the Line E H or I M, &c.

Therefore the Aggregate or Sum of all the Rings, made by the Revolution of the E F's must be equal to that of all the Circles, made by the Motion of the G H's, *i.e.* the Dish-like Solid, form'd by the revolving Rings; will be equal to the Cone, form'd by the Revolution of G H's, which are the Elements of the Triangle A B D; that is the Dish-like Solid will be as the Cone $\frac{1}{3}$ of the circumscribing Cylinder, and consequently the Hemisphere must be $\frac{2}{3}$ of it: wherefore the Sphere is $\frac{2}{3}$ of the circumscribing Cylinder

Let the Radius of the Sphere be $r =$ C D, then the Diameter will be $2r$: let the Surface of the Sphere generated by the revolving Semi-circle, be call'd S, and that of the Cylinder form'd by the Revolution of 2 AC $= 2r =$ Diameter, be call'd f. wherefore, in what was just now prov'd, the Expression for the Solidity of the Sphere in this Notation will be $\frac{1\,rS}{3}$, and putting c equal to the Circumference of the Base, or for the Periphery of a great Circle of the Sphere, the curve Surface of the Cylinder will be $2\,r\,c$; also $\frac{r\,c}{2}$ will be the Area of a great Circle; and this multiply'd by $2\,r$, makes $r\,r\,c$, which is the Solidity of the Cylinder. Now since f was put $=$ to $2\,r\,c =$ the Curve Surface of the Cylinder $\frac{f\,r}{2}$ (by substituting f for $2\,r\,c$) will be also $=$ the Solidity of the Cylinder. Now since the Sphere is $= \frac{2}{3}$ of the Cylinder, $\frac{r\,S}{3} = \frac{2}{3}\ \frac{f\,r}{2}$; that is, $\frac{r\,S}{3} = \frac{2\,f\,r}{6} = \frac{f\,r}{3}$ wherefore $r\,S = r\,f$, that is, dividing by r, $S = f$, or the Surface of the Sphere is equal to the Curve-Surface of the Cylinder; but the Curve Surface of the Cylinder was $2\,r\,c$.

Wherefore to find the Area of the Surface of either Sphere or Cylinder, you must multiply the Diameter ($= 2\,r$) by

the Circumference of a great Circle of the Sphere, or by the Periphery of the Base.

From this Notation also $\frac{rc}{2}$ the Area of a great Circle of the Sphere is plainly $\frac{1}{4}$ of $2rc$, the Surface of the Sphere; that is, the Surface of the Sphere is Quadruple of the Area of the greatest Circle of it.

Wherefore to $2rc$, the Convex Surface of the Cylinder, add rc, equal to the Area of both its Bases, you will have $3rc$; which shews you, that the Surface of the Cylinder (including its Bases) is to the Surface of the Sphere as 3 to 2; or that the Sphere is $\frac{2}{3}$ of the circumscribing Cylinder, in Area as well as Solidity.

SPHERICAL, of or belonging to a Sphere.

SPHERICAL *Geometry*, is the Doctrine of the Sphere; particularly of the Circles describ'd on the Surface thereof, with the Method of Projecting the same upon a Plane.

SPHERICAL *Trigonometry*, is the Art of Resolving Spherical Triangles, *i. e.* from three Parts of a *Spherical* Triangle given, to find the rest.

SPHERICITY, the Quality of a Sphere, or that whereby a Thing becomes spherical or round.

SPHERICKS, *the Doctrine of the Sphere*, particularly of the several Circles describ'd on the Surface thereof, with the Method of projecting the same on Planes.

SPHEROID [in *Geometry*] is a Solid approaching to the Figure of a Sphere; but not exactly round, but oblong; as having one of its Diameters bigger than the other; and generated by the Revolution of a Semi-Ellipsis about its Axis.

When it is generated by the Revolution of a Semi-Ellipsis about its greater Axis, 'tis call'd an *oblong Spheroid*; and when generated by the Revolution of an Ellipsis about its lesser Axis it is call'd an *oblate Spheroid*.

Daviler observes, that the Contour of a Dome should be half a *Spheroid*. Half a Sphere he says is too low to have a good Effect below.

As for the solid Dimensions of a *Spheroid*, it is $\frac{2}{3}$ of its circumscribing Cylinder; or it is equal to a Cone, whose Altitude is equal to the greater Axis, and the Diameter of the Base, to four times the lesser Axis of the generating Ellipsis,

Or a Spheroid is a Sphere describ'd on its greater Axis, as the Square of the lesser Axis to the Square of the greater: or 'tis to a Sphere describ'd on the lesser Axis, as the greater Axis to the less.

To find the Solid Content of a Spheroid.

Multiply the Square of the Diameter of the greatest Circle by the Length, and that Product multiply again by .5236; this last Product will be the Solidity of the Spheroid.

Let A B the Diameter of the greatest be 33 Inches, and C D (the Length) 55 Inches; the Solidity is required.

33

```
       33
       33
     ----
       99
       99
     ----
     1089
       55
     ----
     5445
    5445
    -----
    59895
```

Demonstration.

Every Spheroid is equal to $\frac{2}{3}$ of a Cylinder, whose Base is equal to the greatest Circle of the Spheroid, and its Height equal to the Length of the Spheroid.

Suppose the Figure N T, S N, in the annexed Scheme, to represent a Spheroid, form'd by the Rotation of the Semi-Ellipsis T N S, about its transverse Axis T S.

Let D = T S, the Length of the Spheroid, and the Axis of its circumscribing Sphere, and $d = \text{N}\ n$, the Diameter of the greatest Circle of the Spheroid.

SPIRA } SPIRE } [in the ancient *Architecture*] is sometimes us'd for the Base of a Column, and sometimes for the *Astragal* or *Tore*.

SPIRAL [in *Geometry*] is a Curve of the Circular Kind, which in its Progress recedes from its Centre, as in winding from the Vertex down to the Base of a Cone.

```
        59895
        15236
       ------
       359370
      179685
     119790
    299475
    ----------
    31361.0220 Solidity.
```

SPIRAL [in *Architecture*, &c.] is a Curve which ascends, winding about a Cone or Spire; so that all the Points of it continually approach the Axis; by this it is distinguish'd from the *Helix*, which winds after the same Manner round a Cylinder.

SPLAYING of Windows and Doors. See *Bricklayers*.

SPRINGS for Casements of the common or ordinary Fashion are made for about 6 *d.* *per* Piece.

SQUARE [in *Geometry*] is a Quadrilateral Figure; both equilateral and equiangular; or

A SQUARE is a Geometrical Figure, having four equal Sides, and as many Right (or Square) Angles.

To find the Superficial Content.

Multiply the Side into it self, and the Product is the Content.

Let A B C D be a Geometrical Square given, each Side being 14 Feet, Yards or other Mea-

Meaſure; multiply 14 by it ſelf, and the Product is 196, which is the Superficial Content. See the *Plate*. *Fig.* 5.

$$\begin{array}{r} 14 \\ 14 \\ \hline 56 \\ 14 \\ \hline 196 \end{array}$$

By Scale and Compaſſes.

Extend the Compaſſes from 1 on the Line of Numbers to 14; the ſame Extent will reach from the ſame Point turn'd forward to 196.

Demonſtration.

Let each Side of the given Square be divided into 14 equal Parts, and Lines drawn from one another croſſing each other within the Square; ſo ſhall the whole Square be divided into 196 little Squares, as is to be ſeen in the Figure annexed, equal to the Number of ſquare Feet, Yards or other Meaſures, by which the Side is meaſured.

The Properties of a Square are, that its Angles are all right, and conſequently its Sides perpendicular; that it is divided into two equal Parts by a Diagonal; that the Diagonal of a Square is incommenſurable to its Side.

A Geometrical SQUARE is a plain Figure contain'd under four equal Right Lines, as A B C D, whoſe Angles at A B C D are each Right Angles, in which obſerve, that the Lines A D and C B are the Diagonals; the Lines E H and F G, the Diameters, and the Point I where they all interſect, is the Centre. See *Plate*, *Fig.* 6.

To deſcribe the Geometrical SQUARE A D E F, whoſe ſeveral Sides ſhall be equal to the given Line E G F;

Firſt. Make E F = G H, and on F erect the Perpendicular F D = to G H. Then on the Points E and D, with the Diſtance G H, deſcribe the Arches C C and B B. See *Plate*, *Fig.* 7.

Secondly, Join A E and A D, and they compleat the Geometrical Square A D E F, as required.

SQUARE, an Inſtrument of Braſs or Wood, having one Side perpendicular or at Right Angles to the other, ſometimes made with a Joint to fold for the Pocket; and ſometimes has a Back to uſe on a Drawing Board, to guide the Square.

SQUARE *Number* is the Product of a Number multiply'd by it ſelf: thus 4 is the Product of 2, multiply'd by 2; or 16 the Product of 4, multiply'd by 4, are Square Numbers.

SQUARE *Root*, a *Number* conſidered as the Root of a ſecond Power or ſquare Number, or a Number by whoſe Multiplication into it ſelf, a ſquare Number is generated.

Thus the Number 2, being that by whoſe Multiplication into it ſelf, the ſquare Number 4 is produc'd, is in Reſpect

hereof call'd a Square Root, or the Square Root of 4.

Geometrical SQUARE, is a Compartment frequently added on the Face of the Quadrant, call'd alſo a *Line of Shadows*, and *Quadrant*.

Extraction of the SQUARE ROOT.

If a ſquare Number be given; to find the Root thereof, that is, to find out ſuch a Number, as being multiply'd into it ſelf, the Product ſhall be equal to the Number given, ſuch Operation is call'd, *The Extraction of the Square Root*; which to do, obſerve the following Directions.

1*ſt*. You muſt point your given Number, that is, make a Point or Prick over the Unit's Place, another upon the Hundred's, and ſo upon every ſecond Figure throughout.

2*dly*, Then ſeek the greateſt ſquare Number in the firſt Point towards the left Hand, placing the ſquare Number under the firſt Point, and the Root thereof in the Quotient, and ſubtract the ſaid ſquare Number from the firſt Point and to the Remainder bring down the next Point, and call that the Reſolvend.

3*dly*, Then double the Quotient, and place it, for a Diviſor, on the left Hand of the Reſolvend; and ſeek how often the Diviſor is contain'd in the Reſolvend (reſerving always the Unit's Place) and put the Anſwer in the Quotient, and alſo on the Right-hand Side of the Diviſor; then multiply by the Figure laſt put in the Quotient, and ſubtract the Product from the Reſolvend, (as in common Diviſion) and bring down the next Point to the Remainder (if there be any more) and proceed as before.

A Table *of Squares and Cubes, and their Roots.*

Root		2	3	4	5	6	7	8	9
Squa.	1	4	9	16	25	36	49	64	81
Cub.	1	8	27	64	125	216	343	512	729

Example 1. Let 4489 be a Number given, and let the ſquare Root thereof be requir'd.

```
       4489 (67
       36
      ----
   127) 889 Reſolvend.
        889 Product.
      ----
```

Firſt, Point the given Number, as before directed; then (by the little Table aforegoing) ſeek the greateſt ſquare Number in 44 (the firſt Point to the left Hand) which you will find to be 36, and 6 the Root; put 36 under 44, and 6 in the Quotient, and ſubſtract 36 from 44, and

and there remains 8. Then to that 8 bring down the other Point 89, placing it on the right Hand, so it makes 889 for a Resolvend; then double the Quotient 6, and it makes 12, which place on the left Hand for a Divisor, and seek how often 12 in 88, (reserving the Units Place) the Answer is 7 times; which put in the Quotient, and also on the Right Hand Side of the Divisor, and multiply 127 by 7, (as in common Division) and the Product is 889, which subtracted from the Resolvend, there remains nothing; so is your Work finish'd; and the square Root of 4489 is 67; which Root if you multiply by it self, that is, 67 by 67, the Product will be 4489, equal to the given square Number, and proves the Work to be right.

Example 2. Let 106929 be a Number given, and let the square Root thereof be requir'd.

```
 . . . .
106929(327
 9
———
62)169 Resolvend.
   124 Product.
———
647)4529 Resolv.
    4529 Product.
———
  . . . .
```

First, Point your given Number, as before directed, putting a Point upon the Units, Hundreds, and Tens of Thousands: then seek what is the greatest square Number in 10, (the first Point) which by the little Table you will find to be 9, and 3 the Root thereof; put 9 under 10, and 3 in the Quotient; then substract 9 out of 10, and there remains 1; to which bring down 69, the next Point, and it makes 169 for the Resolvend; then double the Quotient 3, and it makes 6, which place on the left Hand of the Resolvend for a Divisor, and seek how often 6 in 16; the Answer is twice; put 2 in the Quotient, and also on the Right Hand of the Divisor, making it 62. Then multiply 62 by the 2 you put in the Quotient, and the Product is 124; which substract from the Resolvend, and there remains 45; to which bring down 29, the next Point, and it makes 4529 for a new Resolvend. Then double the Quotient 32, and it makes 64, which place on the left Side the Resolvend for a Divisor, and seek how oft 64 in 452, which you will find 7 times; put 7 in the Quotient, and also on the right Hand of the Divisor, making it 647, which multiply'd by the 7 in the Quotient makes 4529, which substracted from the Resolvend, there remains nothing: So 327 is the square Root of the given Number.

Example 3. Let 2268741 be a square Number given, the Root whereof is requir'd.

2268741)

```
2268741)1506.23
1

25)126
   125

3006)18741
     18036

30122)70500
      60244

301243)1025600
       .903729

Remains .121871
```

Having pointed the given Number, as before directed, seek what is the greatest square Number in the first Point 2, which is one; put 1, the Square under 2, and 1, the Root thereof, in the Quotient; subtract 1 from 2, and there remains 1; to which bring down the next Point, 26, and set it on the right Hand, making it 126; double the 1 in the Quotient, which makes 2; set 2 on the left Hand for a Divisor, and ask how often 2 in 12, which will be 5 times; put 5 in the Quotient, and also on the right Hand of the Divisor, making it 25; multiply (as in common Division) 25 by 5, and subtract the Product, 125 from 126, and there remains 1. Bring down the next Point, 87, and it makes 187 for a new Resolvend; and double the 15 in the Quotient, it makes 30 for a new Divisor. Then seek how often 30 in 18, which you can't have; so that you must put 0 in the Quotient, and also on the right Hand of the Divisor, and bring down the next Point, and it makes 18741 for another new Resolvend. Then seek how often 300 in 1874, which will be 6 times; put 6 in the Quotient, and also on the right Hand of the Divisor, multiply and subtract, and the Remainder will be 705. Now, if you have a Mind to find the Value of the Remainder, you may annex Cyphers, by two at a Time, to the Remainders, and so prosecute the Work to what Number of decimal Parts you please; thus, to 705 annex two Cyphers, and it will make 70500 and the Quotient, doubled, is 3012 for a Divisor: Then seek how often 3012 in 7050 (rejecting the Unit's Place) which will be twice; put 2 in the Quotient, and also on the right Hand of the Divisor, and multiply and substract as before, and the Remainder will be 10256; to which annex two Cyphers, and proceed as before, and you will get a 3 in the Quotient next. So the square Root of the given Number is 1506.23, which being squar'd, or multiply'd, by it self, and the last Remainder added, will make the given Number, as follows.

```
                     1506.23
                     1506.23
                     -------
                      451869
                     301246
                    903738
                   753115
                  150623
                  ------------
                  2268728.8129
The Remainder add ——     12.1817
                  ------------
           Proof 2268741.0000
```

Some more Examples for Practice.

```
             . . . .
Example 1.  7596796 (2756.228 Root.
            4
           ---
        47) 359
            329
           ----
        545) 3067
             2725
            -----
        5506) 34296
              33036
             ------
        55122) 126000
               110244
              -------
        551242) 1575600
                1102484
               --------
        5512448) 47311600
                 44099584
                ---------
                  3212016
```

Example 2. 751417.5745 (866.4 Root.

```
         751417.5745(866.4 Root.
         64
      166) 1114
            996
     1726) 11817
           10356
    17328) 146157
           138624
   173364) 753345
           693456
             59889
```

If the given Number be a mix'd Number, *viz.* confifting of a whole Number and a Decimal together, make the Number of decimal Places even, that is, 2, 4, 6, 8, *&c.* that fo there may a Point fall upon the Unit's Place of the whole Numbers, as in this laft Example, and in that following.

Example 3. Let 656714.37512 be given, to find the fquare Root.

```
         656714.375120(8103.79 Root.
         64
     161) 167
          161
   16203) 61437
          48609
  162067) 1282851
          1134469
 1620749) 14838220
          14586741
 Remains    251479
```

In

In this Example there are five Places of Decimals; therefore put a Cypher to it, to make it even, that so there, may a Point fall upon 4 the Unit's Place.

To find the Square Root of a Fraction.

If it be a decimal Fraction, the Work differs nothing from the Examples afore-going, only you must be mindful to point your given Number aright, for (as was before directed) the Number of Places must always be made even, and then begin to point at the right Hand, as in whole Numbers.

If it be a vulgar Fraction, it must be reduc'd to a Decimal.

I shall give an Example or two in each Case, and so conclude.

Let .125 be a decimal Fraction given, whose square Root is requir'd; and let it be requir'd to have four Places of Decimals in the Root.

```
          .  .  .  .
     .12500000(.3535
      9
      ---
  65)350
     325
     ---
 703)2500
     2109
     -----
7065)39100
     35325
     -----
      3775
```

In this Example there must be five Cyphers annex'd, because two Places in the Square, make but one in the Root.

Let the Square Root of .00715 be requir'd.

```
   .007150(.084
      64
      --
  164)750
      656
      ---
       94
```

In this a Cypher is added to make the Places even.

Let $\frac{7}{8}$ be a vulgar Fraction given, whose square Root is requir'd.

```
8)7000              .  .  .  .
  64          (.87500000(.9354
  --            81
   60           --
   56        183)650
   --            549
    40           ---
    40      1865)10100
    --            9325
    ..            -----
           18704)77500
                 74816
                 -----
                  2684
```

Reduce

Reduce this $\frac{7}{8}$ to a Decimal, it makes 875; to which annex Cyphers, and extract the square Root, as if it was a whole Number. So the Root is .935.4

Let $\frac{3}{960}$ be a vulgar Fraction, whose square Root is requir'd.

```
96|0)3.0000000|0
       ....
     288
     ———
      120
       96
      ———
      240
      192
      ———
      480
      480
      ———
      ...
```

```
      . . . . Root.
 (.00312500(.0559.
     25
     ——
 105)625
     525
     ———
1109) 10000
       9981
      —————
         19
```

In extracting the Root of this, because the first Point consists of Cyphers, there must be a Cypher put first in the Quotient.

To prove this Rule, square the Root, and to the Product add the Remainder, as was before directed. To square a Number, is to multiply it by it self; and to cube it, is to multiply the Square of the Number, by the Number it self.

SQUARING [with *Mathematicians*] signifies the making a Square equal to a Circle. Thus the Quadrature or squaring of the Circle, is the finding a Square equal to the Area of a Circle.

STABLE, a Building wherein Horses are kept: It should be plac'd in a good Air, made of Brick, and not of Stone, the first being most wholesom and warmest; for Stone will sweat upon the Alteration of the Weather, which begets Damps and causes Rheums in Horses, neither should there be any unsavoury Gutter, Sink, Jakes, Hog-Sties or Hen-Roost near it.

The Rack should be plac'd neither too high nor too low, and so well posited, that the Hay-Dust fall not into his Neck, Face or Mane: the Manger ought to be of an indifferent Height, made deep, and of one intire Piece, as well for Strength as Conveniency, and the Floor must be pav'd and not plank'd, which is liable to a great many Inconveniencies; nor should there be any Mud or Loam Wall near it, for the Horse will eat

eat it, and that will make him ſick, Loam and Lime being ſuffocating Things, which will infect and putrify the Blood, endanger the Lungs, and ſo ſpoil his Wind.

There ſhould alſo, if Conveniency will permit, be Space in the Stable for a Bed for Servants to lie in; and in the Nook or Corner a great Rack, on which to hang Halters, Saddles, and other Utenſils.

STAIRS [in *Building*] are the Steps whereby we aſcend and deſcend, from one Story of an Houſe to another.

As to the Dimenſions of *Stairs*, they are differently aſſign'd by different Authors; but however, they agree in this, that they muſt not be more than ſix, nor leſs than four Inches high; nor more than 18, nor leſs than 12 Inches broad; nor more than 16, nor leſs than ſix Foot long each Stair.

But theſe Meaſures have only Reſpect to large and ſumptuous Buildings; for in common and ordinary Houſes, they may be ſomething higher and narrower, and much ſhorter; yet even in theſe, the Stairs are not to exceed ſeven, or (at moſt) eight Inches in Height; for if they do, they will be difficult to aſcend: neither ought they to be leſs than nine or ten Inches in Breadth, nor ought their Length to be leſs than three.

To reduce the Dimenſions of Stairs to ſome natural, or at leaſt Geometrical Standard, *Vitruvius* borrows the Proportions of the Sides of a Rectangle Triangle, which the ancient School expreſs'd by the Numbers 3, 4 and 5; that is, three for the Perpendicular from the *Stair Head* to the Ground; 4 for the *Ground Line* it ſelf, or Receſſion from the Wall (ſays Sir *Henry Wootton)* and the fifth for the whole Slope and Inclination, from the Edge of one Stair to that of another.

But this Rule is ſet aſide by modern Builders, and that with good Reaſon; for on this Principle, the lower the Stairs, the narrower they muſt be; and for Inſtance, Stairs four Inches high (ſuch as are found mentioned in ancient Architects) muſt be but $5\frac{1}{3}$ Inches broad, and if a Stair be but ſix Inches high, it muſt be but eight Inches broad, whereas in this Caſe, we ſeldom make them leſs than a Foot broad.

One Rule to be regarded in making of Stairs, is that they be laid according to the *Italian* Phraſe, *con un tantino de ſcarpa*; i. e. *ſomewhat ſloping*, or a little higher behind, that the Foot, may as it were, both aſcend and deſcend at the ſame time; which tho' it is obſerv'd but by few, is found to be a ſecret and delicate Deception of the Pains in aſcending.

Of making Stairs] Tho' there have been Rules laid down for the Height and Breadth of Stairs; yet Workmen are not to be ſo ſtrictly ty'd up to thoſe Rules, as not in the leaſt to vary from them; for they muſt always obſerve, to make all

all the Stairs of the ſame Stair-Caſe of an equal Height and Breadth; in Order to which they muſt firſt conſider the Height of the Room, as alſo the Width or Compaſs they have to carry up the Stairs in.

Then in Order to find the Height of each particular Stair, they ought firſt to propoſe the Height, and to divide the whole Height of the Room by the propos'd Height, which being done, the Quotient will ſhew the Number of Stairs; but if the Diviſion does not fall out exact, but that there be a Remainder; then in this Caſe take the Quotient, (without regarding the Remainder) for the Number of Stairs, and by that Number divide the whole Height of the Room, ſo the Quotient will give you the exact Height of each Stair; as for Example.

Suppoſe the whole Height of the Room to be 9 Foot, 3 Inches, and ſuppoſe you deſign'd to make each Stair 6 Inches high. Turn the whole Height of the Room into Inches, which will be 111 Inches; divide theſe by 6, the Quotient will be 18, and 3 remaining; there let the Number of Stairs be 18, and by it divide 111, and the Quotient will be $6\frac{3}{18}$ or $6\frac{1}{6}$ Inches, which muſt be the exact Height of each Stair.

Then to find the Breadth of each Stair, divide the Width or Compaſs (that you have to carry them up in) by the Number of Stairs, and the Quotient will give the exact Breadth of each Stair.

STAIR-CASE, is an Aſcent inclos'd between Walls, or a Balluſtrade, conſiſting of Stairs or Steps, with Landing Places and Rails; ſerving to make a Communication between the ſeveral Stories of a Houſe, and ſometimes it is us'd to ſignify the whole Frame of a Pair of Stairs only.

The Conſtruction of a compleat Stair-Caſe, ſays Sir *Henry Wootton*, is one of the moſt curious Works in Architecture, and the common Rules are theſe that follow.

1. That it have a full free Light, to prevent Accidents of ſlipping, falling, &c.

2. That the Space over-head be large and airy, which the *Italians* call *un bel Sfogolo*, i. e. *good Ventillation*, becauſe a Man ſpends much Breath in mounting.

3. That the half Paces or Landing Places be conveniently diſtributed for repoſing by the Way.

4. That to avoid Rencounters, and alſo to gratify the Eye of the Beholder, the *Stair Caſe* be not too narrow; but this laſt is to be regulated by the Quality of the Building; and that in Royal Buildings, the principal Aſcent be at leaſt 10 Foot. For a little Stair Caſe in a great Houſe, and a great one in a little Houſe, are both equally ridiculous.

5. That great Care be taken in the placing the Stair Caſe, ſo that the Stairs may be diſtributed without Prejudice to the reſt of the Building, there being much Nicety requir'd in making this Choice.

The Kinds of Stair Cafes are various; in fome the Stairs are *ftrait*; in others, *winding*; in others, *mixt* of both.

1. *Of ftrait Stairs*, fome fly directly forwards, and are called *Flyers*; others are fquare; others triangular, and others are call'd *French Flights*.

2. *Of winding Stairs*, which are alfo call'd *Spiral* or *Cockle Stairs*, fome are fquare, fome circular, and fome elliptical or *oval*.

And thefe again are various, fome winding round a Solid, and others an open Newel.

Laftly *mix'd Stairs* of ftrait and winding, they are alfo of various Kinds, fome are call'd *Dog-legg'd*, others there are that wind about an open Newel, and fly about a fquare open Newel.

Stair-Cafes being of that Importance in Building, it will be neceffary to give a particular Account of each Kind.

I. *Strait Stairs* are fuch as always *fly*, i. e. proceed in a Right Line, and never wind, and for that Reafon are by fome call'd *Flyers*. Of thefe there are feveral Kinds.

1. *Strait Flyers*, or *Plain Flyers*, which proceed directly from one Floor to another, without turning to the right or left; and are feldom us'd, except for Garret or Cellar Stairs in ordinary Houfes.

2. *Square Flyers*, which fly round the Sides of a fquare Newel, either folid or open; having at every Corner of the Newel a fquare ½ Step, taking up ¼ of a Circle, fo that they fly from one half Pace or Step to another, and the Length of the Stairs is perpendicular to the Side of the Newel.

3. *Triangular Flyers*, which fly round by the Sides of a triangular Newel, either folid or open, having at each Corner of the Newel a trapezial half Step, taking up ⅔ of a Circle: fo they fly from one half Step to another, and their Length is perpendicular to the Side of the Newel.

Palladio tells us, that triangular Stairs are to be feen in fome ancient Edifices, and of thefe Sort, he fays, are thofe of the Cupola of St. *Maria Rotunda*, which are open in the middle, and receive Light from above. Thofe alfo of *Sancto Apoftollo* in the fame City, are of the fame Kind.

4. *French Flyers*, which fly firft directly forwards, till they come within the Length of a Stair of the Wall, and then have a fquare half Space, from which you immediately afcend to another half Pace, from which you afcend immediately to another half Pace, from which the Stairs fly directly back again, parallel to their firft Flight.

II. *Winding Stairs* are fuch as always wind and never fly, of thefe alfo there is great Variety: for,

Some wind round a Circle, others round an Ellipfis or Oval; others round a Square, and others round an equilateral Triangle: of each of thefe fome wind round a folid Newel and others, an open or hollow Newel. Again, fome are fe[t]

upo[n]

upon Columns, and some Stairs are double, and some quadruple, of each of which I shall speak briefly.

1. *Circular winding Stairs*; of which there are four Kinds, *viz.* such as wind about a solid Newel, the fore-edge of which being in a Right Line, pointing to the Centre of a Newel; commonly us'd in Church Steeples and great old Houses.

Secondly. Such as wind round an open Newel, the fore-side of which being in a Right Line, pointing to the Centre of the Newel, as those in the *Monument* of *London*.

Thirdly. Such as wind round a solid Newel only, the fore-side of each an Arch of a Circle, either concave or convex, pointing near to the Circumference of the Newel.

In these the Stairs are much longer than in the common winding Stairs.

Of these there may be two Kinds; for their Ichnography being drawn, the Stairs may be contriv'd to be either Concave or Convex on the foreside.

Fourthly. There are other Stairs in all Respects like those last describ'd, only they have an open Newel.

These Kind of Stairs are said to have been invented by *Anthony Barbaro*, a Gentleman of *Venice*.

Any of these winding Stairs take up less Room than any other kind of Stairs whatsoever.

In Stairs that wind round a solid Newel Architects

make the Diameter of the Newel $\left\{\begin{array}{c}\frac{1}{6}\\ \frac{1}{4}\\ \frac{1}{3}\\ \frac{3}{7}\end{array}\right\}$ of the Diameter of

the whole Stair Case; according as the Stair-Case is in Bigness; for if the Stair-Case be very small, they make the Newel but $\frac{1}{6}$ of its whole Diameter; and if very large, then $\frac{3}{4}$, and so proportionably of the rest.

In Stairs that wind round an open Newel, *Palladio* orders the Newel to be $\frac{1}{2}$ the Diameter of the whole Stair-Case, tho' then there does not appear any Reason why these open Newels ought not to be proportion'd to the Size of the Stair-Case, as well as the solid ones.

Then as to the Number of Stairs in each Revolution, he orders,

that if the Stair-Case be $\left\{\begin{array}{c}6 \text{ or } 7\\ 8\\ 9 \text{ or } 10\\ 18\end{array}\right\}$ Foot Diameter, then

there may be $\left\{\begin{array}{c}12\\ 16\\ 20\\ 24\end{array}\right\}$ Stairs in one Revolution about the Newel.

Elliptical winding Stairs. Of theſe there are two Kinds, the one winding round a Solid, and another round an open Newel. They are much of the ſame Nature with circular Stairs, except that in thoſe the Newel is a Circle, and in theſe an Ellipſis or Oval.

Theſe Kinds of Stairs are very handſome and pleaſant, (ſays *Palladio)* becauſe all the Windows and Doors are commodiouſly plac'd in the middle and Head of the Oval. He tells us he has made one of theſe with an open Newel, at the Monaſtery of *Charity* at *Venice.*

Square winding Stairs. Theſe wind round a ſquare Newel, and the fore-ſide of each Stair is a Right Line, pointing to the Centre of the Newel.

Triangular winding Stairs, are ſuch as wind round a triangular Newel, the fore-ſide of which being a Right Line, pointing to the Centre of the Newel. And becauſe the Newel may be either ſolid or open, therefore there are two Kinds of them.

Columniated winding Stairs. Palladio mentions a Stair-caſe in *Pompey*'s Portico at *Rome,* ſet on Columns, ſo as that the Light they receiv'd from above, might diſtribute it to all Parts alike: ſuch another Pair were made by *Bramante* (an excellent Architect) at *Belvedere,* the Pope's Palace.

Double winding Stairs. Scamozzi mentions a Stair-caſe of this Form, made by *Piedro del Bergo,* and *Jean Coffin,* at *Sciamberg* in *France,* in the King's Palace. They are ſo contriv'd that two Perſons, the one aſcending and the other deſcending, ſhall not meet together or come at one another.

Dr. *Grew* deſcribes a Model of this kind of *Stair-Caſe,* in the *Muſeum* of the *Royal Society.* The Foot of one of the *Stair-Caſes,* he ſays, is oppoſite to the other, and both make a parallel Aſcent, and within the ſame Cylinder. The Newel in the middle is hollow, and built with long Apertures to convey Light from Candles, plac'd at the Bottom, and on the Sides of the Newel in both Caſes.

Quadruple winding Stairs. Palladio mentions a Stair-caſe of this Form, which King *Francis* I. cauſed to be made in the Caſtle of *Chambor,* near *Bloyſe*: it conſiſts of four *Stair Caſes* carried up together, having each its ſeveral Entrance and going up one over another, in ſuch Manner, as that being in the middle of the Building, the four ſerve for four Apartments; ſo that the People of the one need not go up and down the Stairs of the other; yet being open in the middle, they all ſee each other paſs, without any Hindrance to one another.

Mix'd STAIRS are ſuch as partly fly, and partly wind; whence ſome call them *Flyers* and *Winders,* of theſe there are ſeveral Kinds, as

Dog-legg'd Stairs, which firſt fly directly forwards, then wind a Semi-circle, and then fly

fly directly backwards, parallel to that.

Square Flyers and Winders. These have a square Newel, either solid or open, and fly by the Sides of the Newel, winding a Quadrant of a Circle at each Corner.

Solid and open newel'd Flyers and Winders, are of two Kinds; the one winds the Quadrant of a Circle about a solid Newel; then flies by the Side of a square open Newel, then winds again by the Side of a solid Newel, then flies again as before, and so alternately. The other flies first, then winds, then flies again alternately.

The Price of Stair-Cases is various, according to their various Kinds, Sizes and Curiosity of Workmanship.

They are sometimes rated at so much *per* Piece, and sometimes at so much *per* Square.

An ordinary Pair of Stairs with Flyers and Winders, of about 6 Foot and 4 Foot, made of Elm Boards, are valued at 2 *s.* 6 *d.* and 2 *s.* 8 *d. per* Stair; the Workmen finding all Materials, as Boards, Nails, &c. but if the Materials are found by the Owner, then 9 *d.* or 10 *d. per* Stair is a good Allowance for Workmanship.

But as for Stair-Cases that have an open Newel, with a Landing Place at every sixth or eighth Stair, being about three Foot all the Way; these Stairs with Rails, Ballusters, String-Boards, Posts, Balls, Pendants, and such other Ornaments, may very well be worth 4 *s.* 6 *d.* 5 *s.* or 6 *s. per* Stair.

STANCHIONS, the same as *Punchins.*

STATUES, a Figure or Statue rais'd over an Order or Building, says M. *Le Clerc*, may have its Height equal to one third of that Column, or to four ninths of it, if the Statue have no Niches.

If it be bigger, it will make the Building appear little; and if it be less, for Instance only a fourth or little more, the Building will appear by much the larger.

It is observable, adds he, that in Proportion, as a Statue is rais'd above the Eye, it appears to diminish in Bulk; till such time, as being elevated to a very great Pitch, it becomes almost imperceptible.

For this Reason some Architects contend, that the Sculptor must always accommodate his Figures to their Height, and increase their Bigness, just as their Elevation increases, to the End that they may always appear of a reasonable Size.

But as the Orders of Columns are diminish'd in Proportion as they rise over one another, it would happen that the Statues in this Case would become too big for the Order.

An Architect must always proportion his Figures to the Orders, and the Stories where they are to be plac'd; unless it happen to be in a close narrow Place, as in a Stair-Case or Dome, for in that Case, the Orders or the Statues may be enlarged in Proportion. But notwithstanding, Care must be taken not to run into Excess, it

being better that they ſhould appear too little, than too big.

Inſtead of placing Statues to finiſh the uppermoſt Stories, one may have Vaſes, Torches, Pots of Incenſe, Trophies and the like Ornaments; which will ſuit better with ſuch Places than Human Figures; unleſs thoſe repreſent the tutelar Angels, appointed for the Guard and Protection of the Building.

STEEL, is an Iron that is very hard in its Nature, and ſometimes is made ſo by Art; it has the ſame Qualities as Iron.

Some have given Steel the Name of *Chalybs*, becauſe anciently brought from a Town in *Aſſyria*, named *Calibone*, where very good Steel was made; but that of *Damaſcus* is preferr'd before all others, and it is found by Experience, that Swords made of it, cut Iron it ſelf.

Our Way of *Steel-making* is to chuſe ſuch Iron as is apt to melt, and yet hard, and which nevertheleſs may be eaſily wrought with the Hammer; for the Iron which is made of Vitriol Ore, tho' it may melt, yet it is ſoft, fragil or eager. Let a Parcel of ſuch Iron be heated red hot, and let it be cut into ſmall Pieces, and then mix'd with that Sort of Stone which eaſily melts, then ſet in the Smith's Forge or Hearth a Crucible, or Diſh of crucible Metal, a Foot and a half broad, and a Foot deep; fill the Diſh with good Charcoal, compaſs the Diſh about with looſe Stones, which may keep in the Mixture of Stones and Pieces of Iron put thereon:

As ſoon as the Coal is thoroughly kindled, and the Diſh is red hot, give the Blaſt, and let the Workman by little and little put in all the Mixture of Iron and Stone he deſigns; when it is melted, let him thruſt into the middle of it, 3, 4, or more Pieces of Iron, and boil them therein five or ſix Hours, with a ſharp Fire, putting in his Rod; ſtir often the melted Iron, that the Pieces of Iron may imbibe the ſmaller Particles of the melted Iron, which Particles conſume and thin the more groſs Particles of the Pieces of Iron, and are, as it were, a Ferment to them, and make them tender.

Let the Workman now take one of the Pieces out of the Fire, put it under the great Hammer to be drawn into Bars and wrought, and then hot as it is, plunge it immediately into cold Water: being thus tempered, let him again work it upon the Anvil, and break it, and looking upon the Fragments, let him conſider whether it looks like Iron in any Part of it, or if it be wholly condens'd and turn'd into *Steel*.

Then let the Pieces be all wrought into Bars, which being done, give a freſh blaſt to the Mixture, adding a little freſh Matter to it, in the Room of that which has been imbib'd by the Pieces of Iron, which will refreſh and ſtrengthen the Remainder, and make the Pieces of Iron put again into the Diſh, the purer; every which Piece, let him, as ſoon as it is red hot, beat into a

Bar

Bar on the Anvil, and caſt it hot as it is into cold Water: and thus Iron is made into *Steel*, which is much harder and whiter than Iron.

STEEL-YARD [in *Mechanicks*] is a kind of Balance, call'd *Statera Romana*, or the *Roman Balance*; by Means whereof the Gravity of different Bodies are found by the Uſe of one ſingle Weight.

It conſiſts of an Iron Beam, A B, wherein a Point is taken at Pleaſure, as C, and on this a Perpendicular rais'd C D. On the leſs Arm A C is hung a Scale or Baſon [or elſe are hung Hooks] as H G to receive the Bodies that are to be weigh'd.

The Weight *I* is ſhifted this Way and that Way on the Beam, till it is a Counter-ballance to one, two, three, four, &c. Pounds, either plac'd in the Scale (or hung upon an Hook) and the Points are mark'd wherein *I* weighs, as one, two, three or four, &c. Pounds. See the *Plate*, *Fig*. 8.

From this Conſtruction of the *Steel-Yard*, the Manner of uſing it is apparent, but the Inſtrument being very liable to Deceit, ought not to be countenanc'd in Commerce. See *Balance*.

Spring STEEL-YARD, a Kind of portable Balance, ſerving to weigh any Matter from about one to forty Pounds.

It is compos'd of a Braſs Tube, into which goes a Rod, and about that is wound a Spring of tempered Steel, in a ſpiral Form. On this Rod are the Diviſions of Pounds and Parts of a Pound, which are ſucceſſively made by hanging on to a Hook, faſtened to the other End, 1, 2, 3, 4, &c. Pounds.

Now the Spring being faſtened by a Screw to the Bottom of the Rod, the greater Weight is hung on the Hook, the more will the Spring be contracted, and conſequently a greater Part of the Rod will come out of the Tube; the Proportions of which greater Weights, are indicated by the Figures appearing againſt the Extremity of the Tube.

STEENING *of Wells*. See *Bricks*.

STEEPLE, is an Appendage erected on the Weſtern End of a Church, to hold the Bells.

Steeples are named from their Form, either *Spires* or *Towers*.

Steeples are ſuch as aſcend continually, diminiſhing either conically or pyramidally.

The latter are mere Parallelopipeds, and are cover'd at Top, Plat-Form like.

In each Kind there is uſually a Sort of Windows or Apertures, to let out Sounds, and ſo contriv'd at the ſame time as to drive it down.

Maſius in his Treatiſe of Bells, treats likewiſe of Steeples.

The moſt remarkable Steeple in the World, is that at *Piſa*, which leans all on one Side, and appears every Moment ready to fall; yet without any Danger.

He obſerves that this odd Diſpo-

Disposition is not owing to the Shock of an Earthquake, as is generally imagin'd; but was so contriv'd at first by the Architect; as is evident from the Ceilings, Windows, Doors, *&c.* which are all in the Level.

STEPS, the same as *Stairs*.

STEREOMETRY, is that Part of *Geometry*, which teaches how to measure solid Bodies, *i. e.* to find the Solidity or solid Content of Bodies; as Cylinders, Cubes, *&c.*

STEREOTOMY is the Art or Science of cutting Solids, or making Sections thereof; as in Profiles of Architecture, in Walls and other Solids to be cut.

STILES [in *Joinery*, *&c.*] are the upright Pieces, which go from the Bottom to the Top in any Wainscot.

STILLATORY, the Room in which a Still or Alembick is set up for Distillation.

STILOBATUM, the Body of the Pedestal of any Column.

STOCK-BRICKS. See *Bricks*.

STONE, is a hard, solid mineral Body, neither fusible nor malleable, form'd in Succession of Time in the Body of the Earth.

Of the Origin and Formation of STONES.

Mr. *Tournefort*, after a curious Survey of the famous Labyrinth of *Crete*, observes that several People had engraven their Names in the living Rock, wherewith its Walls were form'd; and what was very extraordinary, the Letters whereof they consisted, instead of being hollow, as they must have been at first (being all cut with the Points of Knives) were prominent, and stood out from the Surface of the Rock, like so many Basso Relievo's.

This Phænomenon is no other Way to be accounted for, then by supposing the Cavities of the Letters to have been fill'd up insensibly with a Matter issuing out of the Surface of the Rock; and which even issued with greater Abundance than was necessary for filling the Cavity.

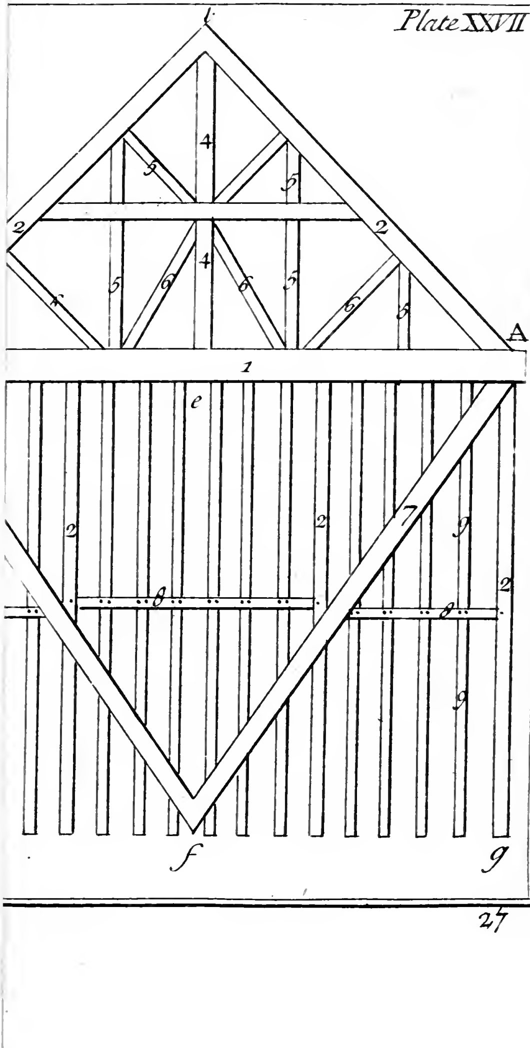
The Wound of the Knife is heal'd up after the same Manner as the Fracture of a broken Bone is consolidated by a Callus, form'd of the extravasated nutritious Juice, which rises above the Surface of the Bone; and this Resemblance is the more proper, the Matter of the Letters being found whitish, when the Rock it self was greyish,

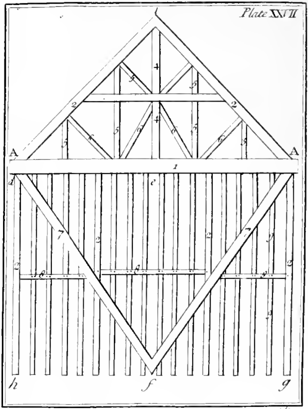
Something very like this is found in the Barks of Trees, in which Letters have been cut with a Knife.

Mr. *Tournefort* supports his Opinion by similar Callus, apparently form'd in several other Stones, which re-unite them after they have been broken by Accident.

From these Observations it follows, that there are Stones which grow in the Quarries, and consequently that they are fed, and that the same Juice that nourishes them, serves to re-unite their Parts, when broken

Plate XXVII





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broken, juſt as in the Bones of Animals, and Branches of Trees when kept up by Bandages; and in fine, that they do vegetate:

If ſo, there is no Room to doubt, but that they are organiz'd, or that they draw their nutritious Juice from the Earth.

This Juice muſt be firſt filtrated and prepar'd in their Surface; which may here be accounted as a kind of Bark; and hence it muſt be convey'd to all the other Parts.

It is highly probable that the Juice which fill'd the Cavities of the Letters, was brought thither from the Bottom of the Roots of the Rock; nor is there any more Difficulty in conceiving this, then in comprehending how the Sap ſhould paſs from the Roots of our largeſt Oaks to the very Extremity of the higheſt Branches.

It muſt indeed be own'd, that the Heart of theſe Trees is extremely hard; and yet thoſe of *Braſile*, &c. call'd Iron Wood, Ebony, *&c.* are much harder.

Coral is as hard in the Sea as out of it; and Sea-Muſhrooms, which all Perſons allow to grow, are real Stones, and ſo, like the common Stones, are us'd in *America* in making Lime of.

It was never doubted but that Shells grew by Means of a nutritious Juice; and yet this Juice is convey'd along the narrow Canals of theſe very hard Bodies, as well as thoſe of Plants, which are not near ſo hard.

So that it muſt be allow'd that ſome Stones do vegetate and grow like Plants. Neither is this all; but there is great Probability that they are generated in the ſame Manner; at leaſt, there is Abundance of Stones, the Generation of which is inconceivable, except they be ſuppos'd to come from a kind of Seed, in which the organical Parts of the Stones are wrapt in, as little as thoſe of the largeſt Plants are in their Grains.

The Stones call'd *Cornu Ammonis, Lapis Judaicus, Aſtroites*; thoſe of *Bologne* and *Florence*, the ſeveral Kinds of *Pyrites*, and a great Number of others, ſuppoſe their ſeveral Seeds; as Muſhrooms, Truffles, and Moſſes of various Kinds, whoſe Seeds were never yet diſcovered.

How ſhould the *Cornu Ammonis*, which is conſtantly in the Figure of a Volute, be form'd without a Seed, containing that ſame Structure in little? where are the Moulds in which they were form'd? and who moulded them ſo artfully? ſo far is it from being ſo, that theſe Stones are found in the Earth, like common Flints, nor have any Thing like Mould been ever diſcovered.

Mr. *Tournefort* examin'd the ſeveral Kinds of Stones abovemention'd, and finds them under the ſame Neceſſity of Seed. Again as to the immenſe Quantity of Flints, wherewith the *Crau of Arles* is covered, is a ſtrong Argument in Behalf of this Theory.

The

The Country there for 20 Miles round, is full of round Flints; which are still found in equal Abundance, to what Depth soever you dig.

M. *Tournefort* observes, that among the Seeds of Stones, there are some which don't only grow soft by the Juices of the Earth; but also become liquid.

These then, if they penetrate the Pores of certain Bodies, grow hard, petrify and assume the Figure or Impression of the Body; thus those that are call'd *Pectinetes*, *Conchytes*, *Ostracites*, *&c.* are real Stones, the Liquid Seeds of which have insinuated into the Cavities of the Shells, call'd *Pecten*, *Concha*, *&c.*

On the Contrary, if these liquid Seeds fall on *Flints*, on Shells, Sand, *&c.* they inclose those several Bodies, and fixing between them, form a kind of Cement, which yet grows like other Stones.

It is highly probable, that such Rocks as are only an Assemblage of masticated Flints, have been form'd by a Number of those liquid Seeds; in like Manner as the Quarries full of Shells, unless the Rocks have invested these Bodies in their Growth.

He likewise adds, that there are Seeds of real Stones, inclos'd in the Spawn of certain Shell-Fish; as well as that hard solid Matter, destin'd to the forming of their Shells.

There is a particular kind of Shell-Fish, call'd *Pholas*, which is never found any where but in the Cavity of Flints, which are always found exactly fitted to receive them.

Now it is highly improbable that the Fish should come and dig such a Niche to spawn in; it is much more likely that the Stones they are found inclos'd in, were at first soft, and that the Matter they are form'd of, was originally found in the Spawn, in like Manner as the Matter which form'd the Egg-Shell, is really found in the Seed thereof.

From the Whole he concludes, that the Seed of Stones, and even of Metals, is a kind of Dust which probably falls from them, while they are alive, *i. e.* while they continue to vegetate, as above.

This Dust may be compar'd to the Seeds of several Plants, as those of *Ferns*, *Capillaries*, *Mosses*, *Truffles*, and the like, which no Microscope ever yet discovered, altho' their Existence is not at all doubted.

Probably Flints and Pebbles are among Stones, what Truffles are among Plants. *Pliny* assures us, that *Theophrastus*, *&c.* believ'd that Stones produc'd Stones; so that this Opinion does not seem improbable.

M. *Geoffry* accounts for the Origin and Formation of Stones, after another Manner.

He lays it down as a Principle, that all Stones without Exception, have been fluid; or at least a soft Paste now dry'd and harden'd; witness the Stones, wherein foreign Bodies are found; also figured Srones, *&c.*

As to the Kinds of Stones, They are various, as *Marble*, *Fire-Stone*, *Purbeck-Stone*, *Rag-Stone*, *Alabaster*, *Free-Stone*, and *Common-Stone*. All which have been already treated on in their proper Places, Alphabetically.

As for *Free-Stone*, there is a Sort of Stone commonly dug in the Peninſula of *Portland*, in *Dorſetſhire*, and commonly known by the Name of *Free-Stone*, which is much us'd in Building, it being much ſofter and whiter than Purbeck-Stone, and is uſually rais'd out of the Quarries in bigger Blocks than Purbeck-Stone.

Some Authors call this *Portland-Stone*, *Free-Stone*, though there is a Sort of Stone found in *Oxfordſhire*, which is call'd *Free-Stone*, and *Rigate*-Stone or *Fire*-Stone, is by ſome Authors call'd *Free-Stone*.

Common-Stone needs no Deſcription, it being that which is commonly us'd and found almoſt every where; and of which I ſhall principally treat here.

Of the Nature of Stones.

The Honourable Mr. *Boyle*, tells us he could eaſily ſhew, that Ways (hitherto unus'd) might be found out (as he has partly try'd) to examine the Nature and Goodneſs of *Marble*, *Alabaſter*, and other Stones.

That a competent Knowledge of the Sap that is to be found in Stones, employ'd in Building, is of ſo great Importance, that experienc'd Artificers have own'd, that the ſame Sort of Stone, taken out of the ſame Quarry, if dug at one Seaſon, will moulder away in a very few Winters, whereas being dug at another Seaſon, it will brave the Weather for very many Years, not to ſay Ages; and again, as there is ſome Sort of Stone that will decay in a few Years, ſo on the contrary there are others which will not attain to their full hardneſs in 30 or 40 Years, or a much longer time.

A certain Author ſays, that there are in ſome Places, Quarries of ſolid and uſeful Stone, which is employ'd about ſome ſtately Buildings, which is of ſuch a Nature, that tho' being dug at a certain Seaſon of the Year, it proves good and durable, yet being employ'd at a wrong time, it makes but ruinous Buildings, as has been found by ſad Experience.

As to the Method of drawing Stones, *i. e.* getting them out of the Quarry. See *Quarry*.

A Load of Stone how much.] 25 Foot of Stone are reckon'd to the Load Superficial Meaſure, not 25 ſolid Feet; but meaſured upon the *Face* of the Stone.

To underſtand this Matter the more clearly, it is to be obſerv'd, that every ſquared Stone has ſix Plains or Sides, *viz.* the upper and under Bed, the Face and the Back, and the two Heads or Ends.

Of theſe ſix Planes, thoſe two oppoſite ones, that are the cleaving Way of the Stone (and which in the Quarry lay paral-

parallel to the Horizon) are call'd the *Beds*; and of the best of the four Planes that are perpendicular to these (and consequently are the breaking Way of the Stone) they make the Face and the Plane opposite to the Face (which commonly goes rough, as it comes from the Quarry) they call the *Back* of a Stone; and the other two perpendicular Planes, are call'd the Heads or Ends.

The Quantity of a Chord of Stones.] In some Places of *Kent*, Stones are sold by the Chord, consisting of 27 solid Feet, *viz.* three Feet long, three broad, and three high.

How much Walling a Load of Stones will do.] A Load of Stones will wall but about 20 Feet of 18 Inch Wall, which is accounted a Medium between what some say, speaking of the two Extremes, 15 and 25.

Soft Stones, how they are wrought smooth.] Some Stones are too soft to bear a good Edge; so that when they are scapt and wrought smooth, their Edges crumble off, and therefore (in this Case) to make them smooth, they proceed thus: After they are scapted, they have an old Card (such as Wool is carded with) and with it they work out the Strokes of the Ax; then bring it to a better liking, by rubbing it with a Piece of the same Stone.

The Price for drawing and carrying Stones, is for the drawing, about 3 *s.* the Load; and carrying (if it be not above half a Mile) 2 *s.* Some say they have drawn them for 9 *d.* the Load, when they lay almost level with the Ground, and requir'd but little uncoping.

As to the Price of scapting Stones.] Some reckon 5 *s.* the 100 Foot, this they say, is Journey-man's Wages, out of which the Master has but a small Profit; 50 Foot is reckon'd a Days Work, tho' some will do 60 in a Day, superficial Measure; and they reckon only the Face of the Stone, tho' they scapt five Sides to each Stone, *viz.* a Face, two Beds and two Ends, so the *Back* goes rough as it comes out of the Quarry. But in *scapting* (if they can conveniently) they chuse that for the Face of the Stone which will be most for their Advantage.

Of the Measuring of Stone Work.] Masons in some Parts of *Sussex*, have a Custom to measure their Stone Work thus; they apply one End of a Line to the Top of the Copeing, and so carry it along the Slant of the Copeing, and press it under the Toothing (if there be any) and from thence they carry it to the Water or Ground Table (if there be any such in the Wall) where they press it in likewise, and then they carry it over the Table to the Bottom of the Foundation; and this Dimension thus taken, they account for the Height, which multiply'd into the Length, gives the Content.

STORIES. Says M. *Le Clerc* in a publick Place intended for the Magnificence, as well as Convenience of a City, the

Buildings cannot be too ſtately: now as nothing carries more State with it, than one grand Order, this is what muſt be thought on in the firſt Place: however as Conveniency on this Occaſion is to be inſeparable from Magnificence, I think two Stories may be allow'd in the Height of this one Order; and if the whole be rais'd on a *Ruſtic* Order, 'twill be a great Addition to the Beauty of the Ordonnance.

Over this grand Order, one may raiſe a Balluſtrade, to make it terminate more agreeably, and to conceal in ſome Meaſure the Roof, which is never found any great Ornament to a beautiful Building.

Inſtead of Pilaſters one might place an Ornament of inſulate Columns with a Corridore or Gallery behind; which would be ſtill infinitely better.

STOVE, a hot Houſe or Room.

Palladio obſerves that the Ancients us'd to warm their Rooms by certain ſecret Pipes, which came thro' the Walls, conveying Heat to ſeveral Parts of the Houſe, from one common Furnace. Whether this were a common Cuſtom, ſays Sir *Henry Wootton*, or a Curioſity, we cannot determine; but it was certainly both for Profit and Uſe, far beyond the *German* Uſe.

STOVE, a Kitchen Term, being a Sort of Furnace, where they dreſs Pottages, and where they prepare Ragoes. It is made of Brick-Work, furniſh'd with Chaffing-Diſhes above, and an Aſh-Pan underneath.

STOVES in Gardens, are Contrivances for preſerving ſuch tender Exotick Plants, which will not live in our Northern Climates, without artificial Warmth in Winter. Theſe are chiefly of two Sorts, call'd *Dry-Stoves* and *Bark-Stoves*.

A Dry Stove is ſo contriv'd, that the *Flues* through which the Smoke paſſes, are either carried under the Pavement of the Floor, or elſe are erected in the back Part of the Houſe, over each other, like Steps.

This Stove may either be built with upright and ſloping Glaſſes at the Top, in the ſame Manner as in the Bark-Stove, or elſe the Front Glaſſes which ſhould run from the Floor to the Ceiling, may be laid ſloping to an Angle of 45 Degrees, the better to admit the Rays of the Sun in *Spring* and *Autumn*.

The latter Method has been chiefly followed by moſt Perſons who have built theſe Sorts of Stoves; but a very ingenious Author ſays, that were he to have the Contrivance of a Stove of this Kind, he would have it built after the Model of the Bark-Stove, with upright Glaſſes in the Front, and ſloping Glaſſes over them, becauſe this will more eaſily admit the Sun, at all the different Seaſons; for in *Summer*, when the Sun is high, the Top Glaſſes will admit the Rays to ſhine almoſt all over the Houſe; and in *Winter*, when the Sun is low, the Front Glaſ-

ſes will admit its Rays; whereas when the Glaſſes are laid to any Declivity in one Direction, the Rays of the Sun will not fall directly thereon above a Fortnight in *Autumn*; and about the ſame time in the *Spring*, and during the other Parts of the Year, they will fall obliquely thereon; and in *Summer*, when the Sun is high, the Rays will not reach above five or ſix Feet from the Glaſſes.

And ſo the Plants plac'd towards the back Part of the Houſe, will not thrive in the Summer Seaſon for want of Air, whereas when they are ſloping Glaſſes at the Top, which run within four Feet of the Back of the Houſe, theſe by being drawn down in hot Weather, will let in perpendicular Air to all the Plants; and of what Service this is to all the Plants, few are ignorant who have made Obſervations on the Growth of Plants in a Stove. For when Plants are plac'd under Covert of a Ceiling, they always turn themſelves towards the Air and Light, and by that Means deviate from their erect Direction, and grow crooked; and if you turn them every Week, in Order to preſerve their erect Poſture, they will nevertheleſs grow weak, and look pale and ſickly.

As to the further Contrivance of this Sort of *Dry Stove*, the Temper of the Place ought to be conſidered, whether the Situation be dry or wet; if it be dry, then the Floor need not be rais'd above two Feet above the level of the Ground; but if it be wet, let it be rais'd three Feet, becauſe as the Flues are to be carried under the Floor, ſo when they are made under, or cloſe upon the Surface of the Ground, they will raiſe a Damp; neither will they draw ſo well, as when they are more elevated.

The Furnace of this Stove may be plac'd either at the back Part of the Houſe, or at one End, according as the Conveniency of the Building does permit.

This alſo muſt be made according to the Fuel intended to be burnt, which if for Coals or Wood, may be made according to the common Method for Coppers, but only much larger, becauſe as the Fire is to be continued in the Night chiefly, ſo if there is not Room to contain a ſufficient Quantity of Fuel, it will require the Trouble of attending the Fire in the Night, which, if neglected, would be of dangerous Conſequence to the Plants.

But if the Fuel intended to be burnt, be Turf; then the Contrivance of the Furnace, may be the ſame as for the *Bark Stove*.

The Flues of this Stove ſhould be turn'd in Angles, after the following Manner, ΛΛΛΛΛΛΛ, which will cauſe them to draw better than if they were ſtrait, and by being diſpos'd in this Method, they will reach from the Back to the Front of the Houſe.

They ſhould not be leſs in Depth

Depth than 18 Inches, and very near the ſame in Width, which will prevent them from being ſoon choak'd up with Soot.

The Spaces between the Flues ſhould be fill'd up with either dry Brick, Rubbiſh, Lime or Sand, from which but little Moiſture can ariſe; and the Flues ſhould be cloſely plaſtered with Loam both within and without, and the upper Part of them covered with a coarſe Cloth under the Floor, to hinder the Smoke from getting into the Houſe.

When the Flue is carried from the Furnace to the End of the Houſe, it may be return'd in the Back, above the Floor, in a ſtrait Line, which may be contriv'd to appear like a Step or two; by which Means the Smoke will be continued in the Houſe, until all its Heat is ſpent: which will warm the Air of the Houſe the better.

The Chimneys thro' which the Smoke is to paſs, may be either at both Ends, or in the middle, carried up in the Thickneſs of the Brickwork of the Walls, ſo as not to appear in Sight.

The Flues ſhould be firſt cover'd either with Iron Plates or broad Tiles, and then a Bed of Sand over them, about two Inches thick, upon which the plain Tiles ſhould be laid, to correſpond with the Reſt of the Floor.

This Thickneſs of Cover will be full enough to hinder the too ſudden Riſe of the Heat from the Flues.

But if the Furnace is plac'd under the Floor, the Thickneſs of Sand between the Iron Plate which covers it and the Floor, ought not to be leſs than four Inches; wherefore the Bottom of the Furnace ought to be ſunk lower; and if the Flues are laid a little riſing from the Fire-Place to the End of the Houſe, it will be a Means to make them draw the better; but this Riſe muſt be allow'd in placing them lower under the Floor, next the Fire, becauſe if the Floor be not laid perfectly level, it would appear unſightly.

Bark Stoves are ſuch as have a large Pit, pretty near the Length of the Houſe, three Feet in Depth, and ſix or ſeven in Breadth, according as the Houſe is in Breadth.

This Pit is to be fill'd with freſh *Tanner's Bark*, to make a hot Bed, and in this Bed, the Pots of the moſt tender Exotic Trees and herbacious Plants are to be plung'd.

The Dimenſion of this Stove ſhould be in Proportion to the Number of Plants that are to be plac'd in it: but as to the Length it ſhould not exceed 40 Feet, except it have two Fire Places, in which Caſe it would be proper to make a Partition of Glaſs in the middle, and alſo two Tan-Pits, that there may be two different Heats for Plants of different Climates, which would be of great Advantage to the Plants, becauſe they may have the Air in each Diviſion ſhifted, by ſliding the Glaſſes of the Partitions, or by opening the Glaſs Door,

Door, which ſhould be made between every Diviſion, altho' there ſhould be three or more Diviſions in the Range, and this Door would alſo be an eaſy Paſſage from one Diviſion to another.

This *Stove* ought to be rais'd above the Level of the Ground proportionally to the Drieneſs of the Place, and the whole ſhould be built on the Top of the Ground, if the Situation be moiſt; ſo that the Brick-work in Front, muſt be rais'd three Feet above the Surface, which is the full Depth of the Bark-Bed; by which Means none of the Bark will be in Danger of lying in the Water.

But on the other Hand, if the Soil be dry, the Brick-work in Front, need not be more than one Foot above Ground, and the Pit may be ſunk two Feet below the Surface.

Upon the Top of this Brick-work, in Front, muſt be laid the Plate of Timber, into which the wooden Work of the Frame is to be faſtened, and the upright Timbers in Front, ſhould be plac'd four Feet aſunder, or ſomewhat more, which is the Proportion of the Glaſs Doors or Saſhes.

Theſe ought to be about ſix Feet and a half, or ſeven Feet in Length, and plac'd upright; but from the Top of theſe ſhould be ſloping Glaſſes, which ſhould reach within three Feet of the Back of the Stove, where there is to be a ſtrong Crown-Piece of Timber plac'd, in which is to be a Groove made for the Glaſſes to ſlide in.

The Wall in the Back of the Stove, ſhould be a Brick and half thick, and carried up about nine Feet above the Surface of the Bark-Bed: and from the Top of this Wall, there ſhould be a ſloping Roof to the Crown Piece in which the Glaſſes ſlide.

This Crown Piece ſhould be in Height about 16 Feet from the Surface of the Bark-Bed or Floor, which will give a Declivity to the ſloping Glaſſes, ſufficient to carry off the Wet, and be high enough to contain many tall Plants. The back Roof of this, may be either covered with Lead, ſlated or tiled.

In the Front of the Houſe there ought to be a Walk about a Foot and half or better wide, for the Conveniency of walking, and next to this ſhould the Bark-Bed be plac'd, which ſhould be proportionable in Width to the Breadth of the Houſe: as if the Houſe be 12 Feet wide, the Pit may be 7 Feet wide; behind which there ſhould be a Walk of a Foot and half, for a Paſſage for watering the Plants in the Pit; and then there will be about 22 Inches vacant next the back Wall, for erecting the Flues, which muſt all be rais'd above the Top of the Bark-Bed; theſe Flues ought to be 16 Inches broad in the Clear, that they may not be too ſoon ſtopp'd with the Soot; and the lower Flue into which the Smoke firſt enters from the Fire,

ſhould

ſhould be two Feet deep in the Clear, and this may be covered either with caſt Iron Plates or broad Tiles; over this the ſecond Flue muſt be returned back again, which may be a Foot and an half deep, and covered on the Top, as before, and ſo in like Manner, the Flues may be return'd over each other three or four times, that the Heat may be ſpent before the Smoke paſſes off.

The Thickneſs of the Wall in the Front of theſe Flues, need not be more than four Inches; but muſt be well jointed with Mortar, and plaſtered withinſide to hinder the Smoke from getting into the Houſe; and the Outſide ſhould be fac'd with Mortar, and cover'd with a coarſe Cloth, to keep the Mortar from cracking; as is practis'd in ſetting up Coppers.

If this be perform'd carefully, there will be no Danger of the Smoke getting into the Houſe, which cannot be too carefully avoided; for nothing is more offenſive to Plants than Smoke, which will cauſe them to drop their Leaves, and if it continue long in the Houſe, will deſtroy them utterly.

The Fire Place may be made either in the middle, or at one End, according as Conveniency will permit, but wherever it is plac'd, it ſhould have a Shed over it, and not be expos'd to the open Air; for if the Wind has full Ingreſs to it, it will be impoſſible to make the Fire burn equally, and it will alſo be troubleſome to attend the Fire in wet Weather, where it is expos'd to Rain.

The Contrivance of the Furnace, ought to be according to the Fuel intended to be burned in it; but Turf being the beſt Fireing for Stoves, where it can be had, becauſe it burns more moderately than any other Sort of Fuel, and ſo requires leſſer Attendance, ſo I ſhall deſcribe a proper Sort of Furnace for that Purpoſe.

The whole of this Furnace ought to be erected within the Houſe, which will be a great Addition to the Heat, and the Front Wall on the outſide of the Fire Place, next the Shed, ought to be two Bricks thick, the better to prevent the Heat from coming out that Way.

The Door of the Furnace at which the Fuel is put in, muſt be as ſmall as conveniently may be, to admit of Fuel; and this Door ſhould be plac'd near the upper Part of the Furnace, and made to ſhut as cloſe us poſſible, ſo that but little of the Heat may paſs off through it.

This Furnace ſhould be in Depth about 20 Inches, and as much ſquare in the Bottom; but may be ſlop'd off on every Side, ſo as to be two Feet ſquare at the Top; and under this Furnace, ſhould be a Place for the Aſhes to fall into, in Depth about a Foot, and of the Width of the Bottom of the Furnace.

This ſhould have an Iron Door, to ſhut as cloſe as poſſible; but juſt over the Aſh-

Hole, above the Bars which ſupport the Fuel, ſhould be a ſquare Hole about four Inches wide, to let in Air to make the Fire burn; this muſt alſo have an Iron Frame and Door, to ſhut cloſe, when the Fire is perfectly lighted, which will make the Fuel laſt the longer, and the Heat will be the more moderate.

The Top of this Furnace ought to be nearly equal to the Top of the Bark-Bed, that the loweſt Flue may be above the Fire, ſo that there may be a greater Draught from the Smoke, and the Furnace muſt be covered with a large Iron Plate, cloſely cemented to the Brick work, to prevent the Smoke from getting out.

Alſo great Care is to be taken, wherever the Fire is plac'd, that it be not too near the Bark-Bed; for the Heat of the Fire will, by its long Continuance, dry the Bark, ſo that it will loſe its Vertue, and be in Danger of taking Fire; to prevent which, it will be the beſt Way to continue a Hollow between the Brick-work of the Fire and that of the Pit, about the Width of a Foot and a half, which will effectually prevent any Damage that might otherwiſe happen from the Heat of the Fire.

And no Wood-work muſt be plac'd any where near the Flues or the Fire Place, becauſe the continual Heat of the Stove may in Time dry it ſo much as to cauſe it to take Fire, which cannot be too carefully guarded againſt.

The Entrance into this Stove ſhould be either from a Green Houſe, the Dry Stove, or elſe through the Shed, where the Fire is made, becauſe in cold Weather, the Front Glaſſes muſt not be opened.

The Inſide of the Houſe muſt be clean white-waſh'd, becauſe the whiter the back Part of the Houſe is, the better it will reflect the Light, which is of great Conſequence to Plants, eſpecially in *Winter*, when you are oblig'd to keep the Stove clean ſhut up.

Over the Top-ſliding Glaſſes, there ſhould either be wooden Shutters or Tarpawlins to roll down over them in bad Weather, to prevent the Wet from getting through the Glaſſes, and alſo to ſecure them from being broke by Storms of Hail; and theſe Outer-Coverings will be ſerviceable to keep out the Froſt.

STRAIT [with *Bricklayers*] a Term us'd for half, or more or leſs than half of a Tile.

Theſe are ordinarily us'd at the Gable Ends, where they are laid at every other Courſe, to cauſe the Tiles to *break Joint* (as they phraſe it) that is that the Joints of one (Courſe) may not anſwer exactly to the Joints of the next Courſe either above or below it.

STRAIGHT ARCH. See *Arch.*

STRETCHERS. See *Arch.*

STRUCTURE. See *Building.*

STRIÆ [in the ancient *Architecture*] are the Liſts, Fillets

lets or Rays, which ſeparate the Striges or Flutings of Columns.

STRIGES [in the ancient *Architecture*] are what in the Modern we call *Flutings*.

They are thus call'd, as ſuppos'd to have been originally intended to imitate the Folds or Plaits of Women's Robes; which are by the *Latins* call'd *Striges*.

STUC [in *Maſonry*] is a Compoſition of Lime and Duſt of white Marble. pounded together and ſifted; of which Figures and other Ornaments in Sculpture are made.

STUFF [with *Joiners*, &c.] the Wood they work on.

STYLOBATÆ, the ſame as *Pedeſtals*.

SUB-CONTRARY *Poſition* [in *Geometry*] is when two ſimilar Triangles are ſo plac'd as to have one common Angle at their Vertex, and yet their Sides not parallel.

SUBDUCTION [in *Arithmetick*] the ſame as *Subtraction*.

SUBDUPLE *Ratio*, is when any Number or Quantity is contain'd in another twice, thus 3 is ſaid to be a Subduple of 6, as 6 is Duple of 3.

SUBSTRUCTION [in *Building*] See *Foundation*.

SUBTENSE [in *Geometry*] is a Right Line oppoſite to an Angle, and preſum'd to be drawn between the two Extremities of the Arch, which meaſures that Angle.

SUMMER [in *Architecture*] is a large Stone, the firſt that is laid over Columns and Pilaſters in beginning, to make a croſs Vault; or it is the Stone which being laid over a Piedroit or Column, is hollowed, to receive the firſt Haunce of a Plat-Band.

SUMMER [in *Carpentry*] is a large Piece of Timber, which being ſupported on two ſtout Peers or Poſts, ſerves as a Lintel to a Door, Window, &c.

There are alſo *Summers* in various Engines, &c. ſerving to ſuſtain the Weight.

SUMMER-HOUSE, a little Edifice erected at the Corner of a Garden, and contriv'd ſo as to let in Air on all Sides; or to exclude it, as you find it refreſhing or inconvenient, by having Windows or Doors plac'd accordingly.

SUMMER-TREE, a Beam full of Mortoiſes, for the Ends of Joiſts to lie in. See *Breſs Summers* and *Girders*.

SUMMET } SUMMIT } the Vertex or Point of any Body, as of a Triangle, a Pyramid, a Pediment, &c.

SUPERCILIUM [in the ancient *Architecture*] the uppermoſt Member of the Cornice, call'd by the Moderns *Corona*, *Crown* or *Larmier*.

It is alſo us'd for a ſquare Member under the upper *Tore* of ſome Pedeſtals. Some Authors confound it with the *Tore* it ſelf.

SUPERFICIES [in *Geometry*] i. e. Surface, a Magnitude conſidered as having two Dimenſions; or extended in Length and Breadth; but without Thickneſs or Depth.

In Bodies the *Superficies* is all

all that preſents it ſelf to the Eye.

A Superficies is chiefly conſidered as the external Part of a Solid, when we ſpeak of a Surface ſimply, and without any Regard to Body, we uſually call it Figure.

A Rectilinear SUPERFICIES, is that comprehended between Right Lines.

A Curvilinear SUPERFICIES, is that comprehended between Curve Lines.

A Plane SUPERFICIES is that which has no Inequality, but lies even between its boundary Lines.

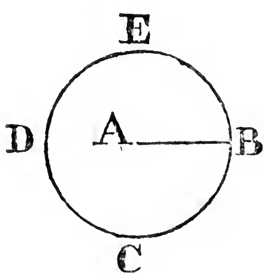
A Concave SUPERFICIES is the internal Part of an orbicular Body.

A Convex SUPERFICIES is the exterior Part of a ſpherical Body.

The Meaſure or Quantity of a Superficies or Surface, is call'd the *Area* of it.

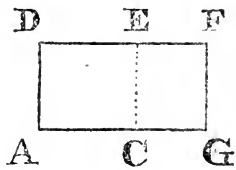
The finding the Meaſure or Area of a Superficies is call'd the Quadrature of it.

SUPERFICIES is that which hath only Longitude and Latitude, that is Length and Breadth without Depth or Thickneſs.



As Right Lines are generated by the Motion of Points ſo are Superficies by the Motion of Right Lines.

For *Firſt*, If the Right Line A B be fix'd at A, as on a Centre, and the Point B mov'd to C, thence to D, and from thence to E, and laſtly to B, it will by its Revolution deſcribe a Superficies, which is call'd a Circle.



2. If the Right Line A D be mov'd along the Line A C, until A C is equal to A D; that is, in the Poſition C E, it will by its Motion deſcribe a Geometrical Square, A D E C, and if continued on to F G, it will generate the Parallelogram A D F G.

SYMMETRY, The Relation or Equality in the Height, Length and Breadth of the Parts neceſſary to compoſe a beautiful Whole.

Vitruvius makes Symmetry to conſiſt in the Union and Conformity of Relation of the Members of a Work to their whole, and of each of the ſeparate Parts to the Beauty of the intire Work; Regard being had to ſome certain Meaſure, ſo that the Body is fram'd with Symmetry by the Relation the Arm, Elbow, Hand, Fingers, *&c.* have to each other, and to their Whole.

SYMMETRY [in *Architecture*]

tecture] is call'd *uniform Symmetry*, and is that where Ordonnance reigns in the ſame Manner throughout the whole Pourtour.

Reſpective SYMMETRY is that wherein the oppoſite Sides are equal to each other.

T

TABERN, a Cellar.

TABLE [in *Architecture*] is a ſmooth ſimple Member or Ornament of various Forms; but moſt uſually in that of a long Square.

A *Projecting Table*, is that which ſtands out from the Naked of the Wall, Pedeſtal, or other Matter it adorns.

Raked Table, is that which is hollow'd in the Die of a Pedeſtal, or elſewhere, as is uſually encompaſs'd with a Moulding.

Razed Table is an Imboſsment in a Frontiſpiece for the putting an Inſcription or other Ornament in Sculpture. This is what M. *Perrault* underſtands by *Abacus* in *Vitruvius*.

Crown'd Table, that which is cover'd with a Cornice, and in which a Baſſo Relievo is cut, or a Piece of black Marble incruſtated for an Inſcription.

Ruſticated Table, that which is pick'd, and whoſe Surface ſeems rough, as in Grotto's, &c.

TABLE [in *Perſpective*] is a Plain Surface ſuppos'd to be tranſparent, and perpendicular to the Horizon.

It is always imagin'd to be plac'd at a certain Diſtance between the Eye and the Objects, for the Objects to be repreſented thereon, by Means of the viſual Rays paſſing from every Point thereof, thro' the Table to the Eye, whence it is call'd a Perſpective Plane.

TABLE *of Glaſs*, See *Caſe of Glaſs*.

TABLES or PANNELS. The Tables in the Die of the Pedeſtal, ought to be equal to the Width of the Column; that is two Modules: now the Width of the Die being two Modules, ſays M. *Le Clerc*, 24 Minutes, there remains 12 Minutes for the Width of the Liſt that goes round it; tho' towards the Bottom it muſt be ſomewhat wider, and may be pretty well fix'd at 15 Minutes.

When theſe Tables are of Marble, he chuſes rather to have them fix'd even with the Die. However, if they are to be ſunk lower, the Inequality ought not ordinarily to exceed a Minute and a half; in which Caſe they ſhould have a Baguette, or a little Talon or Cavetto for a Border.

In theſe Tables are ſometimes added *Baſſo Relievo's* which may be of Marble, of Braſs, or even of Braſs gilt: but ſpecial Care muſt be taken that the Relievo never project beyond the Naked of the Die.

The Sculptor therefore, in this Caſe, muſt take a ſufficient Depth for the Ground of this Work, and the Work it ſelf muſt be rais'd as little as poſſible.

Some Architects bound theſe

Tables with a little Border, projecting beyond the Naked of the Die; but M. *Le Clerc* is of Opinion, that they ought not to be imitated herein, such a projecting Moulding or Frame agreeing very ill with the Astragal above it, and which it self projects nearly as much, as the Baguette that terminates the Bottom of the Corniche.

To which it may be added, that so many little Mouldings being found, almost at an equal Distance from one another, have an ill Effect; for it must be remembred, that the beautiful Distribution of Mouldings, consists in observing a Diversity in their Bignesses, Figures and Distances.

TACKS. See *Nails*.

TAILLOIR [in *Architecture*] a Term us'd by some Writers, in Imitation of the *French*, for *Abacus*.

TALON [in *Architecture*] a Kind of Astragal or Moulding, consisting of a square Fillet, crowning a Cymatium, frequently found to terminate Ornaments of Joiners Work, as those of Doors, *&c*.

TALON. M. *Le Clerc* says, that when a little *Talon* or *Gula* serves as a *Cymaise*, particularly when it terminates an Impost, or when it terminates the Cornice of the Pedestals, He gives it a Fillet something stronger than what he uses to do, when it is found inclos'd between other Mouldings.

He makes the Fillet of the first the stronger, because being more expos'd, it is more liable to be broken; besides, that these last Mouldings always appear more delicate than really they are, by Reason of the Air, which seems to take something off from their Bulk.

The Height of this Fillet, is half that of the Talon, and that of the Second, only a third.

TALUS } [in *Architecture*]
TALUT } the sensible Inclination or Slope of a Work; as of the Outside of a Wall, when its Thickness is diminish'd by Degrees, as it rises in Height, to make it the firmer.

TAMBOUR [in *Architecture*] is a Term apply'd to the *Corinthian* and *Composite* Capitals; as bearing some Resemblance to a Drum, which *Tambour* signifies in *French*.

Some call it Vase, and others the Campana or Bell.

TAMBOUR is also us'd to signify a little Box of Timber Work, cover'd with a Ceiling on the Inside the Porch of certain Churches; both to prevent the View of Persons passing by, and to keep off the Wind by the Means of folding Doors.

TAMBOUR is also us'd for a round Stone, or Course of Stones, several of which serve for a Section of the Shaft of a Column.

TANGENT [in *Geometry*] is a Right Line, which touches a Circle which meets it in such a Manner, as that tho' it were infinitely produc'd, it would never cut the same; that is, never come within the Circumference of it: thus the Line A D, is a Tangent to the Circle in D. See *Plate*, *Fig*. 1.

'Tis demonstrated in the Figure,

gure, that if the Tangent A D, and a Secant A B, be both drawn from the same Point A, the Square of the Tangent will be equal to the Rectangle, under the whole Secant A B, and that Portion thereof A C, will fall without the Circle.

2. That if two Tangents, A D, A E, be drawn to the same Circle, from the same Point A, they will be equal to each other.

TANGENT [in *Trigonometry*] a Tangent of an Arch is a Right-Line, rais'd perpenlarly on the Extreme of the Diameter, and continued to a Point, where it is cut by a *Secant*; that is, by a Line drawn from the Centre, through the Extremity of the Arch whereof it is a *Tangent*.

Or thus, a *Tangent* of an Arch E A, is a Part of a Tangent of a Circle (that is, of a Right-Line which touches a Circle without cutting it) intercepted between two Right-Lines drawn from the Centre C through the Extremes of the Arch E and A. See *Plate, Fig.* 2.

TAPER / TAPERING [in *Joinery*, *&c.*] is understood of a Piece of Board, Timber, or the like, when it is broad beneath, and sharp towards the Top, or diminishing gradually from the biggest End.

TARRASS / TERRASS a Sort of Plaster, or strong Mortar, chiefly us'd in lineing Basons, Cisterns, Wells, and other Reservoirs of Water.

TARRASS / TERRAS [in *Architecture*] an open Walk or Gallery; also a flat Roof of an House.

TASSELS [in *Building*] are Pieces of Board that lie under the Mantle-Tree.

TEETH. See *Dentils*.

TEMPLE [in *Architecture*] The ancient Temples were distinguish'd in Respect to their Construction into various Kinds, as,

TEMPLES *of Antæ*, or single *Antæ*; these, according to *Vitruvius*, were the most simple of all Temples; having only angular Pilasters, call'd *Antæ* or *Parastatæ*, at the Corners, and two *Tuscan* Columns on each Side the Doors.

Tetrastyle TEMPLE or singly TETRASTYLE; was a Temple which had four Columns in the Front, and as many behind; as that of *Fortuna Virilis* at *Rome*.

Prostyle TEMPLE, is one which had Columns only in the Front or Fore-side, as that of *Ceres*, at *Eleusis* in *Greece*.

Amphi-Prostyle TEMPLE, *i.e.* Double Prostyle, was one that had Columns both before and behind, and which was also call'd *Tetrastyle*.

Periptere TEMPLE, one which had four Rows of insulated Columns around, and was also *Hexastyle*. *i. e.* had six Columns in Front; as the Temple of *Honour* at *Rome*.

Diptere TEMPLE, is one which had eight Rows of Columns around, and was also *Octostyle*; or had eight Columns in Front, as that of *Diana* at *Ephesus*.

TENON } [in *Carpentry*, TENNON } &c.] is the End of a Piece of Wood, diminiſh'd by one third of its Thickneſs, to be receiv'd into a Hole in another Piece, call'd a *Mortoiſe*, for the jointing or faſtening the two together.

It is made in various Forms; ſquare, dove-tail'd for double Mortoiſes, and the like.

TENIA. See *Tænia* and *Liſt*.

TERM [in *Geometry*] ſometimes ſignifies a Point, ſometimes a Line, *&c.* a Line is the Term of a Superficies, and a Superficies of a Solid.

TERM } [in *Architecture*] is TERMINUS } a Sort of Statue or Column, adorn'd at the Top with the Figure of the Head of a Man, a Woman, or Satyr, as the Capital, and the lower Part ending in a kind of Sheath or Scabbard.

Theſe *Terms* are ſometimes us'd as Conſoles, and ſuſtain Entablatures; and ſometimes as Statues to adorn Gardens.

Some call theſe *Thermes*, and derive the Name from *Hermes*, a Name given by the *Greeks* to the God *Mercury*, whoſe Statue made after this Manner, was plac'd in ſeveral Croſs-Ways in the City of *Athens*.

Others derive the Name from the *Roman* Deity *Terminus*, who was accounted by them the Protector of Land-Marks.

Whoſe Statue (made without Hands and Feet, that he might not change his Place) was uſually planted at the Bounds of Land, to ſeparate them.

Of theſe *Termin's* the Ancients made great Variety, *viz.* *Angelick*, *Ruſtic*, *Marine*, *Double*, *in Buſt*, *&c.*

Milliary TERMS, among the ancient *Greeks*; were Heads of certain Divinities, plac'd on ſquare Land-Marks of Stone, or on a Kind of Sheath, to mark the ſeveral Stadia, *&c.* in the Roads.

They were uſually dedicated to *Mercury*, whom the *Greeks* believ'd to preſide over Highways. Some of them were repreſented with four Heads; ſuch as are ſtill to be ſeen in *Rome*, at the End of the *Fabrician* Bridge, thence call'd *Ponte de quattre Capi*.

To give them a Figure proper to repreſent a delicate Column, their Arms are lop'd off, and their Body does not appear below the Girdle; theſe *Terms* are very proper in the Decorations of a Theatre, as alſo in Pieces of Architecture, *de Creillage* (as it is call'd by M. *Le Clerc*,) *i. e.* crail'd work Kind.

Theſe *Terms* or *Termini* have this in common with the *Caryates* (or Cariatic Columns) that they ſhould never be brought to match with the common Columns: this Adventage however they have in particular, that you may give them what Degree of Delicacy you pleaſe, by lengthening out their Sheath, and raiſing the Figures to any Height that you would have.

By

By this Means they may be made to ſuit gay, airy Arches, ſuch as Cabinets, Salloons and Arbours, which are requir'd eſpecially in crailed Work.

M. *Le Clerc* adds, that in his Opinion, it is not reaſonable to reduce the Figures of Angels into *Termini*; tho' we ſee it has been formerly done in Places of Diſtinction.

TERRACE } a Bank of
TERRASS } Earth, rais'd in a Garden, Court, *&c.* above the Level of the Ground.

The *Terrace* is a Breaſt-Work, uſually lin'd and breaſted with a ſtrong Wall; in Compliance with the natural Inequality of the Ground.

Sometimes it is made in *Talus*, or aſlope, and cover'd with Turf.

Counter TERRACE, is a Terrace rais'd over another, for the joining of the Ground, or the raiſing a Parterre.

TERRACE [in *Building*] is us'd to ſignify the Roofs of Houſes which are flat, and may be walk'd upon; as alſo Balconies, which project.

The *Terrace* is properly the Covering of a Building which is in Platform; as that of the *Peryſtile* of the *Louvre*; or that of the Obſervatory, pav'd with Flint and Mortar.

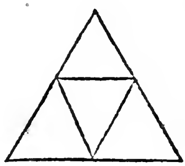
All the Buildings of the Eaſtern Nations are covered with Terraſſes, to take the freſh Air on, and even to lie on.

TESSELATED *Pavement*, is a rich Pavement of Moſaic Work, made of curious ſmall ſquare Marbles, Bricks or Tiles, call'd *Teſſelæ*, from the Form of Tiles.

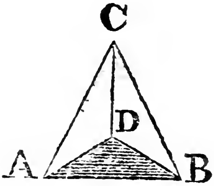
TETRACTYS [in the ancient *Geometry*] the *Pythagoric Tetractys* is a Point, a Line, a Surface and a Solid.

TETRADORON. See *Brick*.

TETRAEDRON } [in
TETRAHEDRON } *Geometry*] is one of the five Regular or Platonic Bodies or Solids; comprehended under four equilateral and equal Angles.



The *Tetraedron* may be conceiv'd as a triangular Pyramid of four equal Faces, as in the Figure.



'Tis demonſtrated by Mathematicians, that the Square of the Side of a *Tetraedron* is to the Square of the Diameter of a Sphere, wherein it may be inſcrib'd in a ſubſeſquialteral Ratio: whence it follows, that the Side of a *Tetraedron* is to the Diameter of a Sphere it is inſcrib'd in, as $\sqrt{2}$ to the $\sqrt{3}$, conſequently they are incommenſurable.

TETRAGON [in *Geometry*] is a Quadrangle, or a Figure

gure with four Angles: thus a *Square*, *Parallelogram*, *Rhombus*, and *Trapezium*, are tetragonal Figures.

TETRAGONISM, is us'd by some to signify the Quadrature of a Circle.

TETRASTYLE [in the ancient *Architecture*] was a Building, and particularly a Temple, having four Columns, both before and behind, *i. e.* in Front and Rear.

THACK TILES. See *Tiles*.

THATCHING, is the Covering the Roof of a House or Barn, with Straw or Reeds.

1. *With Straw*] *Thatch* (says Mr. *Worlidge*,) is a common Covering in many Places, yet in some to be preferr'd before other some; and that the best that he has seen, is that which is call'd *Helin*, *i. e.* long and stiff Wheat Straw (with the Ears cut off) bound up in Bundles unbruis'd; which if well laid, lies thin, lasts long, and is much neater than the common way.

There is commonly allow'd two good Load of Straw for five Square of Thatching, or one Load to 2½ Square.

Some are said to have pretended that they could thatch a Roof, so that no Mouse could get in; but I know no Instance of any such Thing to have been done.

In some Parts of *Kent*, they don't use *Withs* to bind on their thatching Rods, but instead of that, use *Rope-Yarn*, (as they call it) which is a single stranded Line, about the Size of a Penny Cord; pitched with Pitch, after the same Manner as some do their Well Ropes.

This costs about 2 *d. per* Pound, a Pound of which will do a Square of Thatching. This, some say, is more durable than Withs; for that Withs when they are grown Sear, will fly and break, but this will not.

2. *Thatching with Reeds.*] This Kind of Thatching is said to last 40, 50 or 60 Years.

These Reeds in *Sussex* and *Kent*, are sold by the Thousand, *viz.* a 1000 Handfuls, each Handful being 8, 9 or 10 Inches in Circumference, bound up in a little Band, 1000 of which will cost 15 or 16 *s.* and will cover about three Square of Roofing. For laying of which they have 4 *s per* Square.

The Price of Thatching.] Common *Thatching* is done in some Places for 2 *s.* 6 *d.* *per* Square; but in others they have 2 *s.* 8 *d.* and in others 3 *s.* and for *Thatching* with Reeds, 4 *s.*

Of measuring Thatching.] Thatching is measured as *Tileing*, *i. e.* by the Square; and in some Places they are allow'd so many Feet more, as the Corners and Gables are Feet in Length. In other Places they are allow'd only so many half Feet more to the whole, as the Gables Ends are Feet in Length; the Reason they give for this Custom, is, because they have more Trouble in turning the Straw (at the Gable) that it may be cut as it is at the Eaves.

If one Side of a Roof only be

be thatch'd, and not the other, they (then) take their Dimensions over the Ridging, as far as the new Straw goes.

THEATRE } a publick E-
THEATER } difice, for the exhibiting of Spectacles or Shews to the People.

These comprehended not only the Eminence whereon the Actors appear'd, and the Action pass'd; but also the whole Area or Extent of the Place, common to the Actors and Spectators.

In this Sense, the Theatre was a Building, encompass'd with Portico's, and furnish'd with Seats of Stone, dispos'd in a Semi-Circle, and ascending by Degrees over one another, which encompass'd a Space, call'd the *Orchestra*, in the Front of which was the *Proscenium* or *Pulpitum*, on which the Actors perform'd, and which is what is by us properly call'd the *Theatre* or *Stage*.

On the *Proscenium* stood the *Scena*, a large Front, adorn'd with Orders of Architecture, behind which was the *Postcenium* or Place, where the Actors made themselves ready, retir'd, &c. so that the *Scena* in its full Extent comprehended all the Part belonging to the Actors.

The most celebrated Theatres of Antiquity remaining, are that of *Marcellus*, and of *Pompey*, which are call'd Amphitheaters.

THEATER } [among the
THEATRE } *Moderns*] is the Stage or Place whereon the Drama or Play is exhibited, which answers to the Scene of the Ancients.

And in its largest Sense, includes the whole Play-House, *i. e.* a spacious Hall or Room; part of which is taken up by the *Scena*, which includes the Stage, the Decorations and Machines of the Stage; and the Remainder Part, which is distributed into a Space call'd the Pit, which is covered with Seats, Boxes, &c. and an Elevation of one or two Galleries, dispos'd into Benches, rising or ascending one above another.

THEATRE [in *Architecture*] is chiefly us'd by the *Italians* for an Assemblage of several Buildings, which by a happy Disposition and Elevation, represents an agreeable Scene to the Eye.

As that of the Vineyards at *Rome*; that particularly of *Monte Dragone* in *Frescati*, and the new Castle of St. *Germains en Lay* in *France*.

THEODOLYTE, an Instrument us'd in Surveying and taking Heights and Distances.

THEOREM, is a Speculative Proposition, demonstrating the Properties of any Subject.

THEOREM [with *Mathematicians*] signifies a Proposition, which terminates in Theory; and which considers the Properties of Things already made or done. Or it is a Theoretical Proposition, which is deduc'd from several Definitions compar'd together.

Thus if a Triangle be compar'd with a Parallelogram, standing on the same Base, and of

of the ſame Altitude; and partly from their immediate Definitions, and partly from other of their Properties already determin'd, 'tis inferr'd that the Parallelogram is double the Triangle; that Propoſition is a Theorem.

There are two Things in every *Theorem* chiefly to be regarded, *viz.* the *Propoſition* and the *Demonſtration.* In the firſt is expreſs'd what agrees to ſome certain Thing, under certain Conditions, and what does not.

In the latter, the Reaſons are laid down, by which the Underſtanding comes to conceive, that it either does or does not agree thereto.

Theorems are of various Kinds: *Univerſal Theorems*, are thoſe which extend to any Quantity, without Reſtriction, univerſally, as this, that *the Rectangle of the Sizes and Difference of any two Quantities is equal to the Difference of their Squares.*

Particular Theorems, are ſuch as extend only to a particular Quantity.

Negative Theorems, are ſuch as expreſs the Impoſſibility of any Aſſertion; as *that the Sum of any two biquadrate Numbers cannot make a Square.*

Local Theorems are ſuch as relate to a Surface; as that *Triangles of the ſame Baſe and Altitude, are equal.*

Plane Theorems are ſuch as either relate to a Rectilinear Surface, or to one terminated by the Circumference of a Circle; as that *all Angles in the ſame Segment are equal.*

Solid Theorems are thoſe which conſider a Space terminated by a Solid Line, *i. e.* by any of the three Conic Sections; *ex. gr. this*; *that if a Right Line cut two Aſymptotick Parabola's, it's two Parts terminated by them, ſhall be equal.*

Reciprocal Theorems are thoſe whoſe Converſe is true; as that *if a Triangle have two equal Sides, it muſt have two equal Angles*, the Converſe of which is true, *that if it has two equal Angles, it muſt have two equal Sides.*

THEORETICK, THEORETICAL, THEORICK, Relating to Theory, or terminating in Speculation; in which Senſe the Words ſtands in Oppoſition to Practical.

THIMBLES. See *Iron.*

THIRD POINT, TIERCE POINT [in *Architecture*] is the Point of Section in the Vertex of an equilateral Triangle.

Arches or Vaults of the third Point, which the *Italians* call *de terzo acuto*, are ſuch as conſiſt of two Arches of a Circle, meeting in an Angle at the Top.

THOROUGH *Framing.* See *Framing.*

THOROUGH *lighted.* Rooms are ſaid to be thorough lighted, when they have Windows at both Ends.

THROAT [in *Architecture.*] See *Gorge* and *Gula.*

TIGE [in *Architecture*] is a Term uſ'd by the *French* for the

the Shaft or Fust of a Column; comprehended between the Astragal and the Capital.

TILES [in *Building*] are a Sort of thin, factitious or artificial Stones, [of a laminated Figure] us'd in the Roofs of Houses, &c.; but more properly they are a kind of fat clayey Earth, knodden and moulded together, of a just Thickness, dry'd and burnt in a Kiln, like a Brick, and us'd in the Covering of Houses, &c.

Mr. *Leybourn* says, that *Tiles* are made of better Earth than Brick Earth, and something nearer a-kin to Potters Earth.

According to the Statute 17 of *Edw.* IV. the Earth for *Tiles* should be cast up before the *1st* of *November*, shired and turned before the *1st* of *February*, and not made into *Tiles* before the *1st* of *March*; and ought to be try'd and sever'd from Stones, Marl and Chalk.

There are various kinds of *Tiles*, for the various Uses in Building, and those known by several Names, as *Plain*, *Thack*, *Ridge*, *Roof*, *Crease*, *Gutter*, *Pan*, *Crooked*, *Flemish*, *Corner*, *Hip*, *Dorman*, *Dormar*, *Scallop*, *Astragal*, *Traverse*, *Paving* and *Dutch* Tiles.

Plain or Thack Tiles are those in common Use for the Covering of Houses: they are of an oblong Figure, being squeez'd flat, while they are soft.

As to their Dimensions] By the Stat. 13 of *Edw.* IV. are to be 10½ Inches long, 6 broad, and half an Inch and half a quarter thick at least; but these Dimensions are not strictly kept to.

But in *Sussex*, a certain Author tells us, he finds them to be of different Dimensions; some 10 Inches long, 6¾ broad, and ⅝ of an Inch thick; others but 9½ Inches long, 5¾ broad, and about ½ an Inch thick.

As to the Weight.] Mr. *Leybourn* says, that one plain *Tile* weighs about two Pounds and ½; whence 100 of them will weigh about 250 *l.* and 1000 of them, 2500 *l.*

But others say, they have found that a single *Tile* of 10 Inches long, has not weigh'd above 2 *l.* 3 Ounces, so that 100 of them, will not weigh but 220 *l.* and 1000, 2200 *l.* and one of the other Size, weigh'd about two Pounds; so that 100 of them, will weigh but 200 *l.* and 1000, 2000 *l.*

As to their Price,] they are in some Places dearer, and in some cheaper, according to the Scarcity and Plenty of Earth of which they are made, and of the Wood with which they are burnt.

Mr. *Wing* tells us, that they are from 25 to 30 *s.* *per* 1000 in *Rutlandshire*; and Mr. *Leybourn* says, 25 *s.* in *London*; but in *Sussex*, they are sold from 15 to 17 *s.* the 1000.

Ridge Tiles, *Roof Tiles*, *Crease Tiles* } are those us'd for Covering the Ridges of Houses, being made Circular Breadth-wise, like a half Cylinder.

The Dimensions.] These according to the aforesaid Sta-

tute, are to be 13 Inches long, and of the ſame Thickneſs with *Plain Tiles.*

But ſome of them have been found to be 13 Inches long, and 16 broad, by Compaſs on the Outſide, and in Breadth (from Side to Side) on the Inſide about 11 Inches, and ſome not above 9 or 10 Inches.

As to their Weight.] Some of them have been found to weigh about 8 *l.* ¾, ſo that 100 of them will weigh 875 *l.* and 1000, 8750 *l.*

Their Price.] Mr. *Leybourn* ſays, five, ſix, or ſeven of theſe *Tiles*, are allow'd into every 1000 of *Plain Tiles*; but if bought by themſelves, they are ſold from 20 to 25 *s. per* Hundred, and in *Suſſex*, at 2 *d. per* Piece, or elſe 16 *s. per* Hundred.

Hip or Corner Tiles are ſuch as lye on the Hips or Corners of Roofs. As to their Form, they are at firſt made flat like *Plain Tiles*; but of a Quadrangular Figure, whoſe two Sides are Right Lines; and two Ends, Arches of Circles, one End being a little Concave, and the other Convex; the Convex End to be about ſeven times as broad as the Concave End; ſo that they would be triangular, but that one Corner is taken off; then before they are burnt, they are bent on a Mould, Breadth-wiſe, like *Ridge Tiles*: They have a Hole at their narrow End, and are laid and nail'd with their narrow End upwards.

Their Dimenſions.] By the Statute above-mention'd, theſe *Tiles* ought to be 10 Inches ½ long, with convenient Breadth and Thickneſs. But ſome who have meaſured them, ſay they have found them to be 10 Inches in Breadth (according to their Compaſs) at the narrow End two Inches, and at the broad End, 14 Inches; and the Right-lin'd Breadth, at the broad End, about 11 Inches.

As to their Weight.] One of theſe *Tiles* has been found to weigh about three Pounds, and three or four Ounces.

As to their Price.] Mr. *Leybourn* ſays they are uſually ſold at 1½ *d.* or 2 *d. per Tile*, or from 10 to 15 *s. per* Hundred. In *Suſſex* they are ſold for 1½ *d. per* Piece, and 12 *s. per* Hundred.

Gutter Tiles are thoſe which lie in Gutters or Valleys, in Croſs-Buildings. They are made like *Corner Tiles*, only the Corners of the broad End are turned back again with two Wings. They have no Holes in them; but are laid the broad End upwards, without any nailing. They are made in the ſame Mould with *Corner Tiles*; and have the ſame Dimenſions on the out (or Convex) Side. Their Wings are each four Inches broad, and eight long, pointing out ſhort of their narrow End about two Inches.

Their Weight.] Theſe by the Statute are of the ſame Weight with *Corner Tiles*; ſo that 100 of either of theſe kinds of *Tiles*, will weigh about 321 or 322 Pounds; and 1000 of them will weigh 3210, or 3220 Pounds.

Their

Their Price.] These are of the same Price with *Corner Tiles*.

Pan Tiles, *Crooked Tiles*, *Flemish Tiles*, are us'd in covering of Sheds, Lean-to's, and all kinds of flat-rooff'd Buildings. They are in the Form of an oblong Parallelogram, as *Plain Tiles*, but are bent Breadth-wise, forwards and backwards in Form of an S, only one of the Arches is at least three times as big as the other, which biggest Arch is always laid uppermost; and the lesser Arch of another *Tile* lies over the Edge of the great Arch of the former.

They have no Holes for Pins, but hang on the Laths by a Knot of their own Earth.

As to their Dimensions,] they are usually 14 Inches and $\frac{1}{2}$ long, and $10\frac{1}{2}$ broad.

Their Price in most Places is about 7 or 8 *s.* the Hundred.

Dormar, *Dormar*. These *Tiles* consist of a *Plain Tile*, and a triangular Piece of a *Plain Tile*, standing up at Right Angles to one Side of the *Plain Tile*, and swept with an Arch of a Circle from the other End, which End terminates in a Point, or has no Breadth.

Of these Kind of *Tiles* there are two Sorts; for in some the triangular Piece stands on the Right, and in others, on the Left Side of the *Plain Tile*; and of each of these again, there are two Kinds; some having a whole *Plain Tile*; others but half a *Plain Tile*: but in them all, the *Plain Tile* has two Holes for the Pins at that End, where the broad End of the triangular Piece stands.

Their Use.] They are laid in the Gutters between the Roof and the Cheeks or Sides of the Dormers; the *Plain Tile* Part lying upon the Roof, and the triangular Part, standing perpendicularly by the Cheek of the Dormar.

They are excellent for keeping out the Wet in those Places, and yet not perhaps known any where but in *Sussex*.

As to their Dimensions] The Dimensions of the *Plain Tile* Part, are the same with those of a *Plain Tile*, and the triangular Part is of the same Length, and its Breadth, at one End seven Inches, and at the other, nothing.

Their Weight.] One of these *Tiles* is found to weigh about $4\frac{1}{2}$ Pounds, whence 100 of them will weigh 450 Pounds, and 1000 of them, 4500 Pounds.

Their Price.] They are usually sold at $1\frac{1}{2}$*d.* or 2 *d. per* Piece, or 12 or 16 *s. per* 100.

Scallop Tiles, *Astragal Tiles*, are in all Respects like *Plain Tiles*, only their lowers Ends are in Form of an *Astragal*: *viz.* a Semi-Circle with a Square on each Side. They are us'd in some Places for Weather Tileing, and look very handsome.

Traverse Tiles; are a Sort of irregular *Plain Tiles*, having the Pin-Holes broken out, or one of the lower Corners broken off. These are laid with the broken Ends upwards, upon

Rafters, where pinn'd *Tiles* cannot hang.

Paving-Tiles. These are by some call'd *Paving Bricks.* See *Bricks.*

Flemish Tiles } are of two
Dutch Tiles } Sorts, ancient and modern. The ancient *Dutch Tiles* were us'd for Chimney Foot Paces; they were painted with Antick Figures, and frequently with Postures of Soldiers, sometimes with Compartments, and sometimes with Moresque Devices; but fell far short, both as to the Design, and the Colours of the Modern ones.

The Modern *Flemish Tiles* are commonly us'd plaster'd up in the Jaumbs of Chimneys, instead of Chimney Corner-Stones. These *Tiles* are better glaz'd, and such as are painted (for some are only white) are done with more curious Figures, and more lively Colours than the ancient ones.

But both these Sorts seem to be made of the same whitish Clay, as our white glaz'd Earthen Ware; the modern ones are commonly painted with Birds, Flowers, &c. and sometimes with Histories out of the *New Testament.*

Their Dimensions.] The ancient ones are five Inches $\frac{1}{4}$ square, and about $\frac{3}{4}$ of an Inch thick. The Modern *Flemish Tiles* are $6\frac{1}{2}$ Inches square, and $\frac{3}{4}$ of an Inch thick.

As to their Weight.] The ancient Sort weigh $1\frac{1}{4}$ of a Pound, whence 100 of them will weigh 125 Pounds, and 1000, 1250 Pounds.

The modern ones weigh about one Pounds, three Ounces; whence 100 will weigh 169 Pounds, and 1000, 1690 Pounds.

The Price of making and burning Tiles] according to Mr. *Leybourn* is usually 2 *s.* or 2 *s.* 6 *d.* *per* 1000; but some Workmen say, that for Casting the Clay, Shiring it and making it into *Tiles* and burning the *Tiles*, they have 6 *s.* *per* Thousand.

How many Tiles will cover a Square.] This varies according to the different Width they give for the Laths.

At $6\frac{1}{2}$ Inches Gage, 740 *Tiles* will cover a Square.

At 7 Inch Gage, 690; at $7\frac{1}{2}$ Inch Gage, 640, and at 8 Inch Gage, 600 *Tiles* will cover a Square, or 100 Superficial Feet.

These Numbers, suppose the Breadth of the *Tiles* to be six Inches; for (if they are Statute Tiles) they will be thereabout when they are burnt, allowing $\frac{1}{4}$ of an Inch for their shrinking in burning.

If the *Tiles* are broader than six Inches, then a less Number will cover a Square; but if they are narrower, there must be more of them.

Tileing.

By Tileing is meant the Covering of a Roof of a Building with Tiles.

Tileing is measured by the Square of 10 Feet, as Flooring, Partitioning and Roofing were in the Carpenters Work; so that there will not be much Diffe-

Difference between Roofing and Tileing. For Bricklayers ſometimes will require to have double Meaſure for Hips and Vallies.

When Gutters are allow'd double Meaſure, the Way is to meaſure the Length along the Ridge-Tile, and by that Means the Meaſure of the Gutters becomes double; it is alſo uſual to allow double Meaſure at the Eaves, ſo much as the Projecture is over the Plate, which is commonly about 18 or 20 Inches.

Example 1. There is a Roof cover'd with Tiles, whoſe Depth on both Sides (with the uſual Allowance at the Eaves) is 37 Feet, 3 Inches, and the Length 45 Feet; how many Squares of Tileing are contain'd in it?

F.	I.
37	3
45	0
185	
148	
11	3
16 | 76	3

37·25
45
18625
14900
16 | 76.25

Anſwer, 16 Squares, 76 Feet.

Example 2. There is a Roof cover'd with Tiles whoſe Depth on both Sides (with the Allowance at the Eaves is 35 Feet, 9 Inches, and the Length 43 Feet, 6 Inches. How many Squares of Tileing are in the Roof?

F.	I.	
43	6	
35	9	
215		
129		
21		
10 :	10 :	6
17	6	
15 | 15	1	6

35·75
43 5
71875
10725
14300
15 | 55·125

Here the Length and Depth being multiply'd together, the Product is 1555 Feet; which divided by 100 (as is before taught) the Anſwer is, 15 Squares, 55 Feet.

By Scale and Compasses.

In the first Example, extend the Compasses from 1 to 37.25, and that Extent will reach from 45 to 16 Square, and a little above three quarters of a Square.

In the second Example, extend the Compasses from 1 to 35.75, and that Extent will reach from 43.5, to 15 Squares and 55 Feet.

The Price of Tileing.] Tileing in new Work (Mr. *Leybourn* says) and the Workman finding all Materials, as Tiles, Mortar, Laths and Nails, is usually valued at 30 *s.* or 32 *s. per* Square.

Mr. *Hatton* reckons but 28 *s. per* Square.

And for ripping of old Work, and new covering and making good the old, they reckon 12 or 14*s.* the Square, according as they find the old Tileing.

But for Workmanship only, they reckon at *London*, 5 *s. per* Square; but in the Country, the Price is various.

Mr. *Wing* says, 3 *s.* in *Rutland*, and in some Places 2 *s.* 6*d.*

In *Sussex* it is usually done for 3 *s. per* Square, and some say that it is done for 2 *s.* 6 *d.* in some Parts of *Kent*; but then their Tiles are large, and they Lath wide at eight Inch Gages, and pin but half their Tiles, they laying the other half traverse.

And for ripping and healing again (only) Workmanship, *Sussex* Bricklayers reckon 3 *s.* 6 *d. per* Square; and if they Counter-lath it, then 3 *s.* 9 *d.* or 4 *s.*

But in some Parts of *Kent* they Rip and Heal and Counter-lath for 3 *s. per* Square, which is very cheap, but then it is suppos'd they do their Work accordingly.

What Number of Laths and Nails go to a Square of Tileing] See the Articles *Laths* and *Nails.*

The Mortar that is us'd in a Square of Tileing.] The Quantity is $\frac{1}{4}$ of as much Mortar as is allow'd to a Rod of *Brick-work*, will do for a Square of Tileing.

The Number of Pins to a Square.] Mr. *Leybourn* says, they usually allow a Peck of Tile Pins (from 2 *s.* 4*d.* the Bushel) to every 1000 of Tiles; yet some say they use but about a Peck to three Square of Healing, which at 7 Inch Gage is more than enough for 2000 Tiles.

To lay Tiles without Mortar, &c. *i. e.* laying them dry, as they come from the Kiln.

Some lay them in a Sort of Mortar, made with Loam and Horse-Dung.

In some Parts of *Kent*, they have a Way of laying Tiles in *Moss*, which when the Workmen get themselves, they are allow'd 2 *d.* in a Square the more for their Work.

Some do not approve of this Way of Tileing with Moss; because, they say, that in windy, wet Weather, when the Rain, Snow or Sleet is driven under the Tiles (in the Moss) if there follows a Frost, while the Moss is wet, it then freezes and raises the Tiles out of their Places.

Tile-

Tileing with Pan-Tiles.] These Tiles are for the most Part laid dry, without Mortar, yet sometimes pointed withinside.

The Laths on which they hang, are 10 or 12 Feet in Length, and about an Inch and half in Breadth.

They are usually sold at 2 *d.* or 3 *d.* the Lath, or at 10 or 13 *s.* the Hundred.

The Gage for nailing on these Laths (with 4 *d.* Nails) is 10 Inches and a half, and the Breadth of a Tile when laid, is eight Inches; so that about 170 will cover a Square (or 100 Foot) of this Kind of Tileing.

A great Covering with these spends but little Mortar (if pointed) and but little Time in laying.

Mr. *Wing* reckons it worth 1 *s.* 8 *d.* *per* Square laying.

A TABLE, *Shewing the Price or Value of any Number of odd Feet of* Tileing, Slateing, Roofing, Flooring, *&c.* *which is done by the Square of ten Foot, from one Foot to twenty five, or quarter of a Square; and at any Price, from Two Shillings and Six-pence, to five Pound the Square.*

The Price of	s.	d.	s.	d.	s.	d.	s.	d.
Square			6	0	7	0	8	0
$\frac{3}{4}$ Square	3	9	4	6	5	3	6	0
$\frac{1}{2}$ Square	2	6	3	0	3	6	4	0
$\frac{1}{4}$ Square	1	3	1	6	1	9	2	0

The Price of any Number of Feet under 25 Feet, or a quarter of a Square.

	s.	d.	q	s.	d.	q.	s.	d.	q.	s.	d.	q
1	0	0	3	0	0	3	0	0	3	0	1	0
2	0	1	1	0	1	0	0	1	3	0	1	0
3	0	1	3	0	1	3	0	2	2	0	2	2
4	0	2	1	0	2	1	0	3	1	0	3	3
5	0	3	0	0	3	0	0	4	0	0	4	3
6	0	3	3	0	3	3	0	5	0	0	5	3
7	0	4	0	0	4	2	0	5	3	0	6	3
8	0	4	3	0	5	1	0	6	2	0	7	3
9	0	5	2	0	6	0	0	7	1	0	8	3
10	0	6	0	0	6	3	0	8	1	0	9	2
11	0	6	3	0	7	2	0	9	0	0	10	2
12	0	7	1	0	8	1	0	9	3	0	11	2
13	0	7	3	0	9	0	0	10	2	1	0	1
14	0	8	2	0	9	3	0	11	1	1	1	2
15	0	9	0	0	10	2	1	0	0	1	2	1
16	0	9	2	0	11	1	1	1	0	1	3	0
17	0	10	1	1	0	0	1	1	3	1	4	1
18	0	10	3	1	0	3	1	2	2	1	5	0
19	0	11	2	1	1	2	1	3	2	1	6	1
20	1	0	0	1	2	1	1	4	1	1	7	0
21	1	0	3	1	3	0	1	5	0	1	8	1
22	1	1	0	1	3	3	1	5	3	1	9	0
23	1	1	3	1	4	2	1	6	2	1	10	1
24	1	2	1	1	5	1	1	7	3	0	11	0

The Price of the

	s.	d.	s.	d.	s.	d.	s.	d.
Square	9	0	10	0	11	0	12	0
¾ Square	6	9	7	6	8	3	9	0
½ Square	4	6	5	0	5	6	6	0
¼ Square	2	3	2	6	2	9	3	0

The Price of any Number of Feet, under 25, or ¼ of a Square.

	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.
1	0	1	0	0	1	2	0	1	2	0	1	2
2	0	2	1	0	2	1	0	2	1	0	2	0
3	0	3	1	0	3	2	0	3	2	0	3	2
4	0	4	1	0	4	3	0	4	2	0	4	2
5	0	5	2	0	6	0	0	6	0	0	6	0
6	0	6	2	0	7	1	0	7	2	0	7	2
7	0	7	2	0	8	1	0	8	2	0	9	0
8	0	8	3	0	9	2	0	10	2	0	10	0
9	0	9	3	0	10	3	0	11	2	1	0	0
10	0	10	3	1	0	0	1	0	3	1	1	2
11	1	0	0	1	1	1	1	2	1	1	3	0
12	1	1	0	1	2	1	1	3	2	1	4	2
13	1	2	0	1	3	2	1	4	3	1	6	0
14	1	3	0	1	4	3	1	6	1	1	7	2
15	1	4	1	1	6	0	1	7	2	1	9	0
16	1	5	1	1	7	1	1	8	3	2	1	2
17	1	6	1	1	9	1	1	10	1	2	1	0
18	1	7	2	1	9	2	1	11	2	2	1	2
19	1	8	2	1	10	3	2	1	0	1	3	0
20	1	9	2	2	0	0	2	2	1	1	4	1
21	1	10	3	2	1	1	2	3	3	6	6	0
22	1	11	3	2	2	1	2	4	3	1	7	2
23	2	0	3	2	3	2	2	6	1	2	9	0
24	2	1	0	2	4	3	2	7	2	2	10	2

The Price of the

	s.	d.	s.	d.	s:	d.	s.	d.	l.	s.	d.
Square	13	0	14	0	20	0	30	0	2	10	0
¾ Square	9	9	10	6	15	0	22	6	1	17	6
½ Square	6	6	7	0	10	0	15	0	1	5	0
¼ Square	3	3	3	6	5	0	7	6	0	12	6

The Price of any Number of Feet, under 25, or quarter of a Rod.

	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.	s.	d.	q.
1	0	1	3	0	1	2	0	2	2	0	3	3	0	5	0
2	0	3	1	0	3	2	0	4	3	0	7	0	0	9	2
3	0	4	3	0	5	0	0	7	1	0	10	3	1	2	2
4	0	5	2	0	6	2	0	9	2	1	2	1	1	7	0
5	0	7	3	0	8	0	1	0	0	1	6	0	2	0	0
6	0	8	2	0	10	0	1	2	2	1	9	3	2	5	0
7	0	10	3	0	11	2	1	4	3	2	1	0	2	9	2
8	1	0	2	1	1	0	1	7	1	2	4	3	3	2	2
9	1	2	1	1	2	2	1	9	2	2	8	1	3	7	0
10	1	3	2	1	4	2	2	0	0	3	0	0	4	0	0
11	1	5	1	1	6	0	2	2	2	3	3	3	4	5	2
12	1	6	3	1	7	2	2	4	3	3	7	0	4	9	0
13	1	8	0	1	9	0	2	7	1	3	10	3	5	2	2
14	1	10	0	1	10	2	2	9	2	4	2	1	6	7	0
15	1	11	1	2	0	0	3	0	0	4	6	0	6	0	0
16	1	0	2	2	2	0	3	2	2	4	9	3	6	5	0
17	1	2	2	2	3	2	3	4	3	5	1	0	6	9	2
18	1	3	3	2	5	0	3	7	1	5	4	3	7	2	2
19	2	5	3	2	7	0	3	9	2	5	8	1	7	7	0
20	2	7	0	2	8	2	4	0	0	6	0	0	8	0	0
21	2	9	0	2	10	0	4	2	2	6	3	3	8	5	0
22	2	10	0	2	11	2	4	4	3	6	6	0	8	9	2
23	3	0	0	3	1	0	4	7	1	6	10	3	9	2	2
24	3	1	1	3	3	2	4	9	2	7	2	1	9	7	0

The Explanation of the foregoing TABLE.

First, In the Head of the Table, you have the Price of one Square; $\frac{3}{4}$ of a Square; $\frac{1}{2}$ of a Square, and $\frac{1}{4}$ of a Square, placed over each Column, calculated from 5 *s.* the Square, to 40 *s.* the Square; and by Addition, to 5 *l.* &c. *per* Square.

Secondly, In the first Column you have any Number of odd Feet under 25; and in the other Columns, the Price or Rate of any Number of odd Feet, according to the Rate or Price, at the Head of the Column.

The Manner of using the Table *is as follows.*

Look for the Price at the Head of the Table, and under it you will find the Price of $\frac{3}{4}$ of a Square; $\frac{1}{2}$ a Square, and $\frac{1}{4}$ of a Square, and against the odd Feet, their respective Prices.

EXAMPLE I.

What are the Prices of $\frac{3}{4}$ of a Square, $\frac{1}{2}$ a Square, and $\frac{1}{4}$ of a Square, and 18 Feet, at 14 *s.* *per* Square?

	l.	*s.*	*d.*
The Square is - - - - - - -	00	14	00
The $\frac{3}{4}$ of a Square - - - - - -	00	10	06
The $\frac{1}{2}$ of a Square - - - - -	00	07	00
The $\frac{1}{4}$ of a Square - - - - -	00	03	06
The 18 Feet - - - - - - - -	00	02	05
The Sum is	01	03	05

EXAMPLE II.

What comes 22 Feet to, at 13 *s.* *per* Square?

Against 22 Feet in the first Column, and under 13 *s.* at the Head of the Table, is 2 *s.* 10 *d.* which is the Price or Value of 22 Feet, at 13 *s.* *per* Square.

EXAMPLE III.

What comes 24 Feet to, at 1 *l.* 16 *s.* the Square?

In the upper Part of the Table, you cannot find 36 *s.* but you may find 30 *s.* in one Column, and 6 in another.

24 Feet at 30*s.* is 7*s.* $2\frac{1}{4}$*d.* 24 Feet at 6*s.* is 1*s.* $5\frac{1}{4}$*d.* ſo that 24 Feet at 36*s. per* Square, comes to

s.	*d.*
7 :	$2\frac{1}{4}$
1 :	$5\frac{1}{4}$
8 :	$7\frac{1}{2}$

EXAMPLE IV.

What comes 15 Feet to, at 3*l.* 19*s. per* Square?

	l.	*s.*	*d.*
15 Feet at 40*s. per* Square, is - -	0 :	6 :	0
15 Feet at 30*s. per* Sqnare, is - -	0 :	4 :	6
15 Feet at 9*s. per* Square, is - -	0 :	1 :	$4\frac{1}{4}$
The Sum is	0 :	11 :	$10\frac{1}{4}$

EXAMPLE V.

What does 23 Feet come to, at 1*l.* 12*s.* 6*d. per* Square?

	l.	*s.*	*d.*
23 Feet at 20*s. per* Square, is - -	0 :	4 :	$7\frac{1}{4}$
23 Feet at 10*s. per* Square, is - -	0 :	2 :	$3\frac{1}{2}$
23 Feet at 5*s.* 6*d. per* Square, is 1*s.* 1*d.* whoſe half is - -	0 :	0 :	$6\frac{1}{2}$
The Sum is	0 :	7 :	$5\frac{1}{4}$

TIMBER includes all kind of fell'd and ſeaſon'd Woods; or thoſe kind of Trees, which being cut down and ſeaſon'd, are us'd in the ſeveral Parts of a Building, by the *Carpenter*, *Joiner*, *Turner*, *&c.*; theſe when cut down, are call'd *Timber*, and when growing, *Timber Trees.*

The Kinds of Timber are ſo numerous, that it would be tedious to mention them all. I ſhall content my ſelf with mentioning the moſt common kinds of Timber, and their Uſes, as they are found ſet down in Mr. *Evelyn*'s *Sylva*; and Mr. *Worlidge*'s *Syſtema Agriculturæ.*

1. *Oak.* The ſeveral Uſes of oaken Timber for Building and other Mechanick Uſes, are ſo univerſally known, that it would be needleſs to ennumerate them.

There is no Wood comparable to it, for enduring all Seaſons and Weathers; as for Pales, Shingles, Poſts, Rails, Boards, *&c.* For Water Works it is ſecond to none, eſpecially where

it

it lies expos'd to the Air as well as the Water, there is none equal to it.

2. *Elm*; if it be fell'd between *November* and *February*, will be all Spine or Heart, and either none or very little Sap, and is of most singular Use (in the Water) where it lies always wet; and also where it may be always dry. Also the Toughness of it, renders it of great Use to Wheel-wrights, Mill-wrights, &c. it is also good for Dressers and Planks to chop on, because it is not liable to break and fly away in Chips, like other Timber.

3. *Beech*; its chief Use is in Joinery, Turnery, Upholstery, and the like Mechanical Works; the Wood being of a white and fine Grain, and not apt to rend or slit: yet it is sometimes us'd (especially of late Years) for Building Timber, and if it lies always wet (as in Ground Guts and the like) it is judg'd, that it will outlast even Oak it self.

4. *Ash*; the Use of *Ash* is almost universal. It is good for Building or other Occasions, where it may lie dry: it serves the Carpenter, Cooper, Turner, Plough-wright, Wheelwright, &c. and for Garden Uses, no Wood exceeds it; as for Ladders, Hop-Poles, Palisade-Hedges, &c. and also at Sea, for Oars, Hand-Spikes, &c.

5. *Fir*; which is commonly known by the Name of *Deal*, and is of late much us'd in Building, especially within Doors, for Stairs, Floors, Wainscot, and most ornamental Works.

6. *Walnut-Tree Timber* is of universal Use, excepting for the outside of Buildings: there is none better for the Joiner's Use, it being of a more curious brown Colour than Beach, and not so subject to the Worms.

7. *Chesnut Tree*: The Timber of this Tree is next to *Oak*, and is the most sought after by the Joiner and Carpenter, and is of very long lasting, as appears by many ancient Houses and Barns, built of it, about *Gravesend*, in *Kent*.

8. The *Service Tree*: The Timber of this Tree is useful for the Joiner, it being of a very delicate Grain, and is fit for divers Curiosities. It also affords Beams of a considerable Bigness for Building.

9. The *Poplar*, *Abel and Aspen*; which Kinds of Timber are very little different from one another, and of late, are much us'd instead of *Fir*; they look well, and are tougher and harder.

10. *Alder* is useful for the Poles of Ladders and Scaffolds, and also for Sewers and Pipes, for Conveyance of Water; for if it lie always wet, it will harden like a Stone it self; but where it is sometimes wet, and sometimes dry, it rots immediately.

11. *Lime-Tree*: Of this have been made Ladders, which have been excellently good, and of a very great Length.

The Time of felling Timber.

The Season of felling Timber, usually commences about the

the End of *April* (because at that Time, the Bark generally rises the most freely, and if there be any Quantity of Timber to be fell'd, the Statute obliges to fell it then, the Bark being necessary for the Tanner.

But the Opinions and Practices of Authors have been very different concerning the best Time to fell Timber.

Vitruvius recommends an autumnal Fall: others advise *December* and *January*: *Cato* was of Opinion, that Trees should have bore their Fruit before they were fell'd, at least their Fruit should be first ripe, which falls in with the Sentiment of *Vitruvius*.

And indeed tho' Timber unbark'd, be most obnoxious to the Worm, yet we find the wild Oak, and Timber fell'd too late, when the Sap begins to be proud, to be very subject to Worms; whereas being cut about Mid-Winter, it neither casts, rifts or twines, because the Cold of the Winter does both dry and consolidate it.

It would be happy therefore for our Timber, if a Method of tanning without so much Bark, could be found out, as the Honourable Mr. *Charles Howard* has most ingeniously offer'd, were become universal, that Trees being fell'd more early, the Timber might be fell'd more early, so as to be better season'd and condition'd for its various Uses.

The Ancients had a great Regard to the Age of the Moon, in felling their Timber, and the Presence of *Diana* in *Sylvis* or the Woods, was not so much celebrated to credit the Fictions of the Poets, as for the Dominion of that moist Planet, and her Influence upon Timber.

If their Rules avail any Thing, they are these: Fell Timber in the Wane or Decrease, or four Days after the New Moon; and some advise, that it be in the last Quarter. *Pliny* advises, that it be in the very Article of the Change, which happening in the very last Day of the Winter-Solstice (he says) that Timber will prove immortal.

Columella says, from the 20th to the 30th Day: *Cato* says, four Days after the Full: *Vegetius* says, from the 15th to the 25th for Ship Timber; but never in the Increase, Trees then abounding with Moisture, which is the only Source of Putrefaction.

Some have Regard even to the Temper and Time of the Day, the Wind to be low, neither East nor West; neither in frosty, wet or dewy Weather, and therefore never in the Forenoon.

Lastly, Regard is to be had to the Species of Timber. It is best to fell Fir, when it begins to spring; both as it then quits its Coat best, and as the Wood (according to *Theophrastus*, is by that Means rendered wonderfully durable in Water.

Elm, says Mr. *Worlidge*, is to be fell'd between *November* and *January*; in which Case it will be all Heart; at least the Sap will be very inconsiderable:

derable: He adds, that this is the only Seaſon for felling *Aſh.* Some Authors adviſe in the felling of Timber, to cut it but into the Pith, and ſo to let it ſtand till dry; by which Means the Moiſture is evacuated in Drops, which would otherwiſe cauſe Putrefaction.

The Method of Seaſoning Timber.

After Timber has been fell'd and ſawn, it is next to be ſeaſon'd; for the doing of which ſome adviſe that it be laid up very dry in an airy Place, yet out of the Wind and Sun, at the leaſt, free from the Extremities of either; and that it mayn't decay, but dry evenly, they order that it be daub'd over with Cow Dung.

Let it not ſtand upright, but lay it along, one Piece upon another, only kept a-part by ſhort Blocks interpos'd, to prevent a certain Mouldineſs, which they are apt to contract by ſweating one upon another; which frequently produces a *Fungus*, eſpecially if there be any ſappy Parts remaining.

Others adviſe to lay Boards, Planks, &c. in ſome Pool or running Stream for a few Days, to extract the Sap from them, and afterwards to dry them in the Sun or Air. They ſay, that by this Means, they will neither chap, caſt, nor cleave. Mr. *Evelyn* particularly commends this Way of Seaſoning for Fir. Againſt ſhrinking there is no Remedy.

Some again adviſe to bury them in the Earth; others in Wheat; and others are for ſcorching and ſeaſoning them in Fire, eſpecially Piles, Poſts, &c. that are to ſtand, either in Water or Earth.

Sir *Hugh Plat* informs us, that the *Venetians* burn and ſcorch their Timber in the flaming Fire, continually turning it round with an Engine, till it has got a hard, black, cruſty Coal upon it. And the Secret carries great Probability with it, for that the Wood is brought by it to ſuch a Hardneſs and Drieneſs, that neither Earth nor Water can penetrate it.

Mr. *Evelyn* tells us, that he himſelf had ſeen Charcoal dug out of the Ground, amongſt the Ruins of ancient Buildings, which in all Probability had lain covered with the Earth for near 1500 Years.

Of preſerving Timber.

When Timber or Boards, &c. have been well ſeaſon'd or dry'd in the Sun or Air, and fix'd in their Places, and what Labour you intend is beſtow'd upon them, Care is to be taken to defend and preſerve them, to which the ſmearing them with Linſeed Oil or Tar, or the like oleaginous Matter, contributes much to their Preſervation and Duration.

Heſiod preſcribes to hang your Inſtruments in the Smoke to make them ſtrong and laſting; if ſo, ſurely the Oil of Smoke (or the vegetable Oil by ſome other Means obtain'd) muſt

muſt needs be effectual for the Preſervation of Timber.

The Practice of the *Hollanders* deſerves our Notice, who, to preſerve their Gates, Port Cullis's, Draw-Bridges, Sluices, &c. coat them over with a Mixture of Pitch and Tar, whereon they ſtrew ſmall Pieces of Cockles and other Shells, beaten almoſt to Powder, and mix'd with Sea Sand; which incruſt and arm it wonderfully againſt all Aſſaults of Wind and Weather.

When Timber is fell'd before the Sap is perfectly at reſt, it is very ſubject to the Worms; but to prevent and cure this, Mr. *Evelyn* recommends the following Secret, as the moſt approv'd.

Put common Sulphur into a Cucurbit, with as much *Aqua Fortis* as will cover it three Fingers deep; diſtil it to a Drieneſs, which is perform'd by two or three Rectifications.

Lay the Sulphur that remains at the Bottom, being of a blackiſh or ſad red Colour, on a Marble, or put it in a Glaſs, and it will diſſolve into an Oil; with this Oil anoint the Timber which is infected with Worms, or to be preſerv'd from them.

It is a great and excellent *Arcanum* (he tells us) for tinging the Wood of no unpleaſant Colour, by no Art to be waſh'd out; and ſuch a Preſervative of all Manner of Woods, nay of many other Things alſo; as Ropes, Cables, Fiſhing-Nets, Maſts of Ships, &c. that it defends them from Putrefaction, either in Water, under, or above the Earth; in Snow, Ice, Air, *Winter* or *Summer*, &c.

It were ſuperfluous to deſcribe the Proceſs of making the *Aqua fortis*; it ſhall ſuffice to let you know, that our common *Copperas* makes this *Aqua fortis* well enough for our Purpoſe, being drawn over by a Retort. And as for *Sulphur*, the Iſland of St. *Chriſtophers* yields enough (which hardly needs any refining) to furniſh the whole World.

This Secret for the curious I thought not proper to omit, tho' a more compendious Way may ſerve the Turn, three or four anointings, as to Poſts, &c. this has been experimented in a Walnut Tree Table, where it has deſtroy'd Millions of Worms immediately, and is to be practis'd for Tables, Tubes, Mathematical Inſtruments, Boxes, Bed-Steads, Chairs, &c. the Oil of Walnuts will doubtleſs do the ſame; is ſweeter and better than Varniſh; but above all, Oil of Cedar, or that of Juniper is commended.

As for Poſts or the like that ſtand in the Ground, the burning the Outſides of thoſe Ends that are to ſtand in the Ground, is a great Preſervative.

Sir *Hugh Plat* tells us of a *Kentiſh* Knight of his Acquaintance, who us'd to burn the Ends of his Poſts for Railing and Paling; and this was likewiſe practis'd by Mr. *Walter Cuckfield* of *Suſſex*, Eſquire, with very good Succeſs.

And this Practice was probably

bably deduc'd from the Obſervations that ſeveral made who digged the Earth, and found Charcoal, which, as they conjectured, had lain there 100 Years (nay Eſq; *Evylin* ſays 1500) and yet was not in the leaſt inclin'd to Putrefaction, but was very firm and ſolid; which is a plain Demonſtration, that Timber thus prepar'd, will reſiſt Putrefaction much longer than it can do without it.

That this burning the Ends of Timber, is alſo practiſed in *Germany*, as appears by the Abſtract of a Letter written by *David Vanderbeck*, a *German* Philoſopher and Phyſician at *Minden*, to Doctor *Largelot*, regiſtred in the *Philoſophical Tranſactions*, N. 92. Page 585, in theſe Words: Hence alſo they ſlightly burn the Ends of Timber to be ſet in the Ground, that ſo by the *Fuſion* made by the Fire, the *volatile Salts* (which by Acceſſion of the Moiſture of the Earth would eaſily be conſum'd to the Corruption of the Timber) may catch and fix one another.

Of cloſing the Chops or Clefts in Green Timber.

Green Timber is very apt to ſplit aud cleave after it is wrought into Form; which is a great Eye Sore in fine Buildings.

This may be done by anointing, ſuppling and ſoaking it with the Fat of powdered Beef Broth, twice or thrice repeated; and the Chaps fill'd with Spunges, dipt into it; this is to be done, as has been ſaid, twice or thrice over.

Some Carpenters make Uſe of Greaſe and Saw Duſt, mingled together for the ſame Purpoſe; but the firſt is ſo good a Way, (ſays our Author) that I have ſeen *wind-ſhock'd Timber* ſo exquiſitely clos'd, as not to be diſcern'd where the Defects were. But this muſt be done while the Timber is green.

Of meaſuring of Timber.

Timber is commonly meaſured and ſold by the Tun or Load, which is a ſolid Meaſure, containing 40 or 50 ſolid Feet, *viz.* 40 Feet of round Timber, aud 50 Feet of hewn Timber; the Denomination of Load or Tun is ſuppos'd to ariſe from hence, that 40 or 50 ſolid Feet of ſuch Timber, weighs about a Tun, *i. e.* 20 Hundred Weight, which is uſually accounted a Cart Load.

1. *For meaſuring of Round Timber.*] The Cuſtom is to gird the Tree about in the middle of the Length, and folding the Line twice to take one Length or a quarter of the whole, and to account that for the true Side of the Square. Then for the Length, 'tis accounted from the But-end of the Tree, ſo far up as the Tree will hold *half a Foot Girt*, as they phraſe it, *i. e.* as long as the Line twice folded, is half a Foot.

The Dimenſions thus taken, the Quantity of Timber may be meaſured, either, by multiplying the Side of the Square in

in it ſelf, and that Product will be the Length by the Method of *Croſs Multiplication.*

But more eaſily and ſpeedily on *Gunter's Line*, by extending the Compaſſes from 12 to the Side of the Square in Inches; for that Extent turn'd twice (the ſame Way) from the Length in Feet, will reach to the Content in Feet.

But better ſtill on *Coggleſhal's* Sliding Rule, by ſetting 12 on the Girt Line D, to the Length of Feet in the Line C: then againſt the Side of the Square, on the Girt Line D, taken in Inches, you have on the Line C, the Content of the Timber in Feet.

Note 1. This Method of meaſuring round Timber, tho' it is common, is very erroneous; and the Content that is found hereby, 'tis demonſtrated is leſs than the true Content or Meaſure in the Ratio of 11 to 14.

How to avoid this Error, and meaſure it juſtly, is ſhewn under the Uſe of *Coggleſhal's Sliding Rule.* Which ſee.

2. If the Tree have any great Boughs or Branches that have Timber (as they phraſe it) *i. e.* which will hold half a Foot Girt, they are uſually meaſured and added to the reſt: the Solidity of the whole being thus found, they divide it by 40, which brings it into Loads or Tuns.

3. In meaſuring Round Timber for Sale, they uſually caſt away an Inch out of the Squares for the Bark, if Oak; ſo that a Tree 10 Inches ſquare, they reckon it as if it were but 9; but for *Aſh*, *Elm* and *Beach*, an Inch is too much to be allow'd for the Bark.

Again, this Way of taking $\frac{1}{4}$ of the Circumference for the true Square, is erroneous, and always gives the Solidity leſs than the Truth, by about a fifth Part.

For meaſuring hewn or ſquared Timber.] The Cuſtom is to find the middle of the Length of the Tree, and there to meaſure its Breadth, by clapping two Rules or other ſtrait Things to the Sides of the Tree, and meaſuring the Diſtance between them; in the like Manner they meaſure the Breadth the other Way: If the two be unequal, they add them together, and take half the Sum for the true Side of the Square.

The Dimenſions thus taken, the Content is found either by *Croſs Multiplication*, *Gunter's Scale*, or the *Sliding Rule*, after the Manner already directed, the Content divided by 50, gives the Number of Loads.

If the unequally, this Method of meaſuring it, is erroneous; always giving the Content more than the Truth, and the more ſo, as the Difference of the Sides is the greater; yet Cuſtom has authoriz'd it, to meaſure ſuch Timber juſtly, a mean Proportional ſhould be found between the unequal Sides; and this mean be accounted the Side of the Square.

The Measuring of Board *and* Timber.

1. *Of Board-Measure.*

To measure a Board, is no other but to measure a long Square.

Example 1. If a Board be 16 Inches broad, and 13 Feet long, how many Feet is contain'd therein?

Multiply 16 by 13, and the Product is 208; which divided by 12, gives 17 Feet, and 4 remains, which is a third Part of a Foot.

Or thus: Multiply 156 (the Length in Inches) by 16, and the Product is 2496; which divided by 144, the Quotient is 17 Feet, and 48 remains, which is a third Part of 144, the same as before.

$$\begin{array}{r} 12 : 13 :: 16 \\ 13 \\ \hline 48 \\ 16 \\ \hline 12)208 \\ \hline 17\tfrac{4}{12} \end{array}$$

$$\begin{array}{r} \text{Or, } 144 : 156 :: 16 \\ 16 \\ \hline 936 \\ 156 \\ \hline 144)2496(17\tfrac{48}{144} \\ \hline 1056 \\ \hline 48 \end{array}$$

By Scale and Compasses.

Extend the Compasses from 12 to 13, that Extent will reach from 16 to $17\frac{1}{3}$ Feet, the Content.

Or, extend from 144 to 156, (the Length in Inches) that Extent will reach from 16 to $17\frac{1}{3}$ Feet, the Content.

Example 2. If a Board be 19 Inches broad, how many Inches in Length will make a Foot?

Divide 144 by 19, and the Quotient is 7.58 very near; and so many Inches in Length, if a Board be 19 Inches broad, will make a Foot.

$$\begin{array}{ccccccc} \text{I.} & & \text{I.} & & \text{I.} & & \text{I.} \\ 19 & : & 144 & :: & 1 & : & 7.58\ \textit{fere.} \end{array}$$

Extend the Compasses from 19 to 144, that Extent will reach from 1 to 7.58; that is, 7 Inches, and something more than a half. So, if a Board be 19 Inches broad, if you take 7 Inches and a little more than a half with your Compasses from a Scale of Inches, and run that Extent along the Board, from End to End, you may find how many Feet that Board contains; or you may cut off from that Board, any Number of Feet desir'd.

For this Purpose there is a Line upon most ordinary Joint-Rules, with a little Table plac'd upon the End of all such Numbers as exceed the Length of the Rule, as in this little Table annex'd.

0	0	0	0	5	0	8½	6
12	6	4	3	2	2	1	1
1	2	3	4	5	6	7	8

Here you see, if the Breadth be one Inch, the Length must be 12 Feet; if two Inches, the Length is 6 Feet; if five Inches broad, the Length is 2 Feet, 5 Inches, &c.

The rest of the Lengths are express'd in the Line: thus if the Breadth be 9 Inches, you will find it against 16 Inches, counted from the other End of the Rule; if the Breadth be 11 Inches, then a little above 13 Inches, will be the Length of a Foot, &c.

§ 2. *Of Squar'd Timber.*

By Squar'd Timber is here meant all such as have equal Bases, and the Sides strait and parallel.

Example 1. If a Piece of Timber be 1 Foot, 3 Inches (or 15 Inches) square, and 18 Feet long, how many solid Feet are contain'd therein?

	F.	I.	
15	1	3	
15	1	3	
75	1	3	
15		3	9
225	1	6	9
18			6
1800			
225	9	4	6
			3
144)4050(28.125	28	1	6
1170			
180			
360			
720			

Answer, 28 Feet and half a quarter.

Here, instead of multiplying by 18, (where I wrought by Feet and Inches) I multiply'd by 6, and then by 3, because 3 times 6 is 18.

Example 2. If a Piece of squar'd Timber be 2 Feet 9 Inches deep, and 1 Foot 7 Inches broad, and 16 Feet 9 Inches long, how many Feet of Timber are in that Piece?

Multiply the Depth, Breadth and Length together, and the Product will be the Content.

		F.	I.		
33		2	9		
19		1	7		
297		2	9		
33		1	7	3	
627		4	4	3	
16.75		16	9		
3135		69	8	0	
4389		3	3	2	3
3762					
627		72	11	2	3

144) 10502.25 (72.93

422
1342
465

33

Anſwer, 72 Feet, 11 Inches; or, 72 Feet, 93 Parts.

By Scale and Compaſſes.

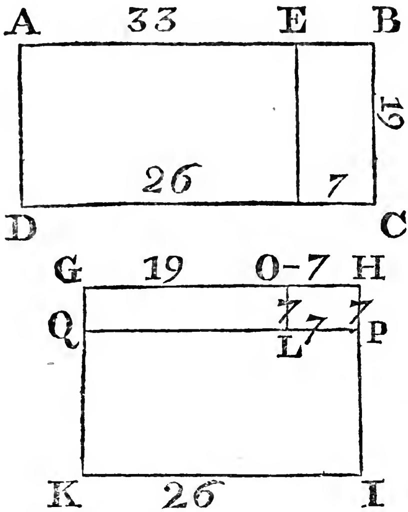
For the firſt Example, extend the Compaſſes from 12 to 15 Inches, (the Side of the Square) that Extent will reach from 18 Feet (the Length being twice turn'd over) to 28 Feet and ſomething more.

For the ſecond Example, find a mean Proportional between 19 Inches and 33 Inches, by dividing the Space between them into two equal Parts; and the Compaſs Point will reſt upon .25, which is a mean Proportional between 19 and 33.

Then extend the Compaſſes from 12 to 25, (the Proportional found) that Extent will reach (being twice turn'd over) from 16.75 Feet, the Length, to 72.93 Feet, the Content.

A common Error is committed, for want of Art, in meaſuring theſe laſt Sorts of Solids, by adding the Depth and Breadth together, and taking half for the Side of a mean Square. This Error, tho' it be but ſmall, when the Depth and Breadth be pretty near equal; yet if the Difference be great, the Error is very conſiderable; for the Piece of Timber, thus meaſur'd, will be more than the Truth, by a Piece whoſe Length is equal to the Length of the Piece of Timber

Timber to be meaſur'd, and the Square equal to half the Difference of the Breadth and Depth, as I ſhall here demonſtrate.



I ſay, the Square G H I K, is greater than the Parallelogram A B C D, by the little Square O H P L; for the Parallelogram Q P I K, is equal to the Parallelogram A E F D; and the Parallelogram G O L Q, is equal to the Parallelogram E B C F. Therefore the Square is greater than the Parallelogram, by the little Square O H P L; which was to be prov'd.

Otherwiſe, you may prove it by Numbers, thus; the Sum of 33 and 19, is 52; the half thereof is 26; the Square of 26 is 676; and the Product of the Depth and Breadth, is 627; the Difference of theſe two is 49, equal to the Square of half the Difference; for the Difference between 33 and 19, is 14, the half thereof is 7, whoſe Square is 49. Which was to be prov'd.

Now, if this 49 be multiply'd by the Length of the Piece, and that Product divided by 144, te bring it to Feet, and thoſe Feet added to the true Content, the Sum will be equal to the Content, found by the falſe Way mention'd.

See

See the Work of both.

33 Depth.
19 Breadth.

52 Sum.

26 half.
26

156
52

67.6
16·75

3380
4732
4056
676

144)11323.00(78.63

1243
910
460

28

16.75 the Length.
49 the Square of ½ Diff.

15075
6700

4)820.75(5.69

1007
1435

139

Feet
To 72.93 the true Content,
Add 5.69 the Part superfluous.

Rem. 78.62 equal to the Content by the false Way.

By Feet and Inches.

F.	I.		
0	7		
0	7		
0	4	1	
16	9		
5	5	4	
	3	0	9
5	8	4	9 Part superfluous.
72	11	2	3 true Content add.
78	7	7	0 equal to the Content by the false Way.

F.	I.	
2	2	
2	2	
4	4	
	4	4
4	8	4
16	9	
75	1	4
3	6	3
False C. 78	7	7

To find how much in Length makes a Foot of any squar'd Timber.

Always divide 1728 (the solid Inches in a Foot) by the Area of the Base; the Quotient is the Length of a Foot.

This Rule is general for all Timber, which is of equal Thickness from End to End, whether it be square, triangular, multangular, or round.

Example 1. If a Piece of Timber be 18 Inches square, how much in Length will make a Foot solid?

```
       18
       18
      ---
      144
       18
      ---
324)1728(5 1/3
     1620
     ----
      108
```

Answer, 5 Inches and $\frac{1}{3}$

By Scale and Compasses.

Extend the Compasses from 1 to 18, that Extent will reach from 18 to 324, the Square or Area of the Base; then extend from 324 to 1728, that Extent will reach down from 1 to 5 Inches and $\frac{1}{3}$ of an Inch.

Or thus: Extend the Compasses from 18 to 41.569, that Extent turn'd twice over from 1, will at last fall upon $5\frac{1}{3}$, as before.

Note, That 41.569 is the square Root of 1728.

Example 2. If a Piece of Timber be 22 Inches deep and 15 Inches broad, how much in Length will make a Foot?

22
15
———
110
22
———
330)1728(5.23
———
780
1200
———
210

Anſwer, 5 Inches and .23 Parts.

By Scale and Compaſſes.

Extend the Compaſſes from 1 to 15, that Extent will reach from 22 to 330; then extend from 330 to 1728, that Extent will reach from 1 to 5.23 Inches, the Length of a Foot.

There is a Line for this Purpoſe upon moſt ordinary Rules, with a little Table at the End of all ſuch Numbers as exceed the Length of the Rule, ſuch as this annex'd.

0	0	0	0	9	0	11	3	9	Inches.
144	36	16	9	5	4	2	2	1	Feet.
1	2	3	4	5	6	7	8	9	Side of the Sq.

Here it is to be ſeen, that if the Side of the Square be 1, the Length muſt be 144 Feet; if two Inches be the Side of the Square, it muſt be 36 Feet in Length, to make a ſolid Foot, *&c.*

If the Side of the Square be not in the little Table, it may be found upon the Line; thus if the Side of the Square be 16 Inches, you will find it againſt 6 Inches, and 7 tenths, counted from the other End of the Rule.

Then, if you take the Length of a Foot from the Line of Inches with the Compaſſes, and run the Compaſſes along the Piece from End to End, you will find how many Feet are contain'd in that Piece; or you may cut off any Number of ſolid Inches that ſhall be deſir'd; but if the Sides of the Piece be unequal, then you are to find a mean Proportional Number, as has been before taught, by dividing the Diſtance upon the Line of Numbers into two equal Parts.

Thus, if the Breadth be 25 Inches, and the Depth 9 Inches, divide the Space upon the Line of Numbers into two equal Parts, and you will find the middle Part at 15: ſo is 15 Inches the Geometrical mean Proportional ſought; then if you look for 15 upon the Line above-mentioned, you will find 7 Inches and a little above half to be the Length of a Foot.

§ 3. *Unequal Squar'd Timber.*

Unequal ſquar'd Timber is all ſuch as hath unequal Baſes; *i. e.* that is thicker at one End than the other; and ſuch the Generality of Timber Trees are, when they are hewn and brought to their Squares.

The uſual Way of meaſuring ſuch Timber is, to tak

a Square about the middle of the Piece, which is ſuppos'd to be a mean Square: This Way comes pretty near to the Truth, when the Piece is pretty near as thick at one End as at the other; but the Error is very conſiderable, when there is a great Diſproportion between the Ends of the Piece, all ſuch Solids being the *Fruſtums* of *Pyramids*; the true Way of meaſuring them muſt be by the Directions given for meaſuring the *Fruſtum* of a *Pyramid*. See *Pyramid*, and *Fruſtum of a Pyramid*.

I ſhall give an Example or two, wrought both by the true and the falſe way; by which you may ſee the Difference.

Example 1. If a Piece of Timber be 25 Inches ſquare at the greater End, and 9 Inches ſquare at the leſſer End, and 20 Feet long, how many Feet of Timber are in that Tree?

25
9
Sum 34
Half 17 the Side of the Square in the middle.
17
119
17
289
20
144) 5780 (40.13
0200
560
128

Anſwer 40.13 Feet, by the falſe Way.

25	25
9	9
225	16 Difference of the Sides.
	16
	96
	16
	3)256 the Square.
	85.333
	225
	310.333
	20
	144)620.6660(43.101
	446
	146
	266
	122

Answer 43.101 Feet by the true way; so that there is near 3 Feet difference.

By Scale and Compasses.

Extend the Compasses from 1 to 9, that Extent will reach from 25 (the same way) to 225 the Rectangle of the Sides of the two Bases; then the Difference between the said Sides is 16: extend the Compasses from 3 to 16, and that Extent will reach from 16 to 85.333, a third Part of the Square; which being added to 225, the Sum is 310.333 a mean Area: then extend the Compasses from 144 to 310.333, and that Extent will reach from 20, the Length, to 43.1 Foot, the Content the true way.

Extend the Compasses from 12 to 17 (the Side of the middle Square) and that Extent will reach from 20 (the Length being twice turn'd over) to 40.1. Feet, the Content by the false way.

Example 2. If a Piece of Timber be 32 Inches broad and 20 Inches deep, at the greater End, and 10 Inches broad and 6 deep at the lesser End, and 18 Foot long, how many Feet of Timber are in that Piece?

32

32
20
———
640
60
———
38400
1
———
29)284
385)—2300
3909)—375000
39185)—231900
391909)—359750

144)5375·754(37·33
———
1055
477
455
———
23

6
10
——
60

195·959 mean Prop.
640 the greater Base.
60 the lesser Base.
———
895·959 the Sum.
6⅔ the Height.
———
5375·754

Add	32	20
	10	6
Sum	42	26 Sum.
Half	21	13 half.

21
13
——
63
21
——
273 Area in the mid.
18 Length.
———
1284
273
———
144)4914(34.12
———
594
180
360
———
72

Answer { Content the true way 37·33 Feet. Content the false way 34.12 Feet. }

By

By Scale and Compasses.

Extend the Compasses from 1 to 20, and that Extent will reach from 32 to 640, the Area of the greater Base.

Then extend them from 1 to 60, and that Extent will reach from 640 to 38400, the Product of the two Areas.

Find the square Root of it, by dividing the Space between 1 and 38400 into two equal Parts, and so you will find the middle Point at 195.959 the Root sought; which is a mean Proportional between the greater and lesser Areas.

Then add the mean Proportional and two Areas together, and the Sum will be 895.959; which being multiply'd by 6 (a third Part of the Length) by extending from 1 to 6, and that Extent will reach from 895.959, to 5375.75.

Then extend them from 144 to 5375.75, and that Extent will reach from 1 to 37.33 Feet the true Content.

For the false way, half the Sum of the Breadths is 21, which is the Breadth in the middle; and half the Sum of the Depths is 13: Extend the Compasses from 1 to 13, and that Extent will reach from 21 to 273, the Area of the middle Base: then extend them from 144 to 273, and that Extent will reach from 18 (the Length) to 34.12, the Content the false way.

Of measuring round Timber, whose Bases are equal.

The common way of measuring round Timber Trees, is to girt them about the middle with a String, and to take the fourth Part of that Girt for the Side of a Square, by which the Piece of Timber is measured as if it was square.

But that this is an Error, will be made appear by what follows.

If the Circumference of a Circle be 1. the Area will be .07958; then the fourth Part of 1 is .25, which being squared, makes .0625; this they suppose to be a mean Area, instead of .07958: therefore the true Content always bears such Proportion to the Content found by the said customary false way, as .07958 to .0625; which is nearly as 23 to 18; so that in measuring by that customary false way, there is above the one fifth Part lost of what the true Content ought to be.

This Error, tho' it has been so often confuted, yet it is grown so customary every where, that there is but little Hopes of prevailing with Persons to embrace the Truth; but however, I shall proceed in the following Examples to give the Operations both by the true way, and the false customary way.

Example 1. If a Piece of Timber be 96 Inches in Circumference or Girt, and 18 Feet in Length, how many Feet of Timber does it contain?

a fourth Part of 96 is 24
24
———
96
48
———
576 Area Base.
18
———
4608
576
———
144)10368
1008
———
288
288
———
...

Or thus F.　I.
2　0
2　0
———
4　0
18
———
72　0

Content the false way, 72 Feet.

The Operation the true way.

96
96
———
576
864
———
9216
107958
———
73728
46080
82944
64512
———
733.40928 the Area
18
———
586727424
73340928
———
13201.36704
———

44)13201.36704(91.67
———
241
973
1096
———
88

The true Content 91.67 Feet.

By Scale and Compasses.

Extend the Compasses from 12 to 24 (the fourth Part of the Girt) and that Extent turn'd twice over from 18 Feet (the Length) will at last fall upon 72 Feet, the Content the customary way.

Extend again from 42.54 to 96

96 (the Girt) and that Extent will reach from 18 Feet (turn'd twice over) to 91.67 Feet the true Content.

Example 2. If a Piece of Timber be 86 Inches Girt, and 20 Feet long, how many Feet does it contain?

The fourth Part of 86 is 21.5

F.	I.	P.	
1	9	6	
1	9	6	
1	9	6	
1	4	1	6
	0	10	9
3	2	6	3
			20
64	2	5	0

```
       21.5
       21.5
      -----
       1075
       215
      430
     ------
     262.25
         20
     ------
144)9245.00(64.2
     605
      290
      ---
       20
```

The Content the falſe way, 64.2 Feet.

The Operation the true way.

```
     86
     86
    ---
    516
   688
   ----
   7396
  07958
  -----
  59168
 36980
66564
51772
---------
588.57368
```

```
        588.57368
               20
144)11771.47360(81.74
      251
      1074
       667
       ---
        91
```

The true Content is 81.74 Feet.

By Scale and Compasses.

Extend the Compasses from 12 to 21.5, and that Extent turn'd twice over from 20, will reach at last to 64.2 Feet; the Content the false way.

Again, extend the Compasses from 42.64 to 86, and that Extent turn'd twice over from 20, will at last fall upon 81.74 Feet, the true Content.

§ 4. *The measuring of Round Timber, whose Bases are unequal.*

The customary way of measuring Round Timber (as has been said before) is to take a fourth Part of the Girt in the middle of the Piece, for the Side of a mean Square.

But this way has been prov'd to be erroneous in Timber that is all the Length of an equal Thickness; and it must of Necessity be much more so in Timber that is tapering; and the greater will the Error be, the more tapering the Timber is. For to an Error in the last foregoing Section, there will be added the Error in the preceeding Section; therefore in order to measure all such Timber according to Art and Truth, such a Piece ought to be considered as a *Frustum* of a Cone, and should be measured by Rules given for measuring that; by which Rules the following Examples are wrought.

Example 1. If a Piece of Timber be 9 Inches Diameter at the lesser End; and 36 Inches at the other End, and 20 Feet in Length, how many Feet of Timber does it contain?

```
       36     36 } Subtract.
        9      9 }
      ---    ---
Rect. 324     27 Difference.
              27
             ---
             189
             54
             ---
          3)729 the Square.
             ---
             243 one third.
             324 Rectangle add.
             ---
             576

                 7854
                  567
                -----
                54978
               47124
              39270
             --------
             445.3218 a mean Area.
                   24
             --------
             17812872
             8906436
             ----------
        144)10687.7232(74.22
             ----
             607
              317
               292
               ---
                 4

   Answer 74.22 Feet.
```

Or

Or thus, by Feet and Inches.

F.	I.		F.	I.		
3	0		2	3		Difference.
0	9		2	3		
2	3 Rect.		4	6		
			0	6	9	
			5	0	9	the Square.
			1	8	3	one third.
			2	3	0	Rect. added.
			3	11	3	a mean Sq.

F. I. P.

Then as 14 is to 11, so is 3 : 11 : 3 to the Area.

```
           3 : 11 : 3
                    11
       ---------------
       7)43 :  3 :  9
       ---------------
       2) 6 :  2 :  3
       ---------------
          3 :  1 :  1 : 6
                        6
       ------------------
         18 :  6 :  9 : 0
                        4
       ------------------
         74 :  3 :  0 : 0
```

Here instead of dividing by 14, I divide by 7 and by 2, because twice 7 is 14.

And instead of multiplying by 24 Feet (the Length) I multiply by 6 and by 4, because 6 times 4 is 24.

By Scale and Compasses, this is too troublesome.

Example 2. If a Piece of Timber be 136 Inches in Circumference at one End, and but 32 Inches Circumference at the other End, and 20 Feet in Length, how many Feet of Timber does that Piece contain?

```
  136          136
   32           32
 ----         ----
  272          104 Difference.
 408           104
 ----         ----
 4352          416
              104
             -----
           3)10816 the Square.
             -----
              3605.333 one third.
              4352     Rectangle add.
             ---------
              7957.333 a mean Circum. ſquar'd.
               .07958
             ---------
             63658664
            39786665
           71615997
          55701331
          ------------
          633.24456014 the mean Area.
                    21
          ------------
          633.24456014
        12664 8912028
        --------------
        13298.13576294

      144)13298.13(92.34
          --------
            338
             501
              693
             ----
              117
               Anſwer 92.34 Feet.
```

By Feet and Inches thus.

F.		I.		
11	:	4		
2	:	8		
22	:	8		
7	:	6	:	8
32	:	2	:	8

F.		I.						
8	:	8						Difference.
8	:	8						
69	:	4						
5	:	9	:	4				
3)75	:	1	:	4				the Square.
25	:	0	:	5	:	4		
30	:	2	:	8	:	0		
55	:	3	:	1	:	4		the Sq. of the (Circumference.

				F.		I.		P.		S.	
88	:	7	::	55	:	3	:	1	:	4	the mean Area.
										7	
				11)386	:	9	:	9	:	4	
				8) 35	:	1	:	11	:	9	
				4	:	4	:	8	:	11	the mean Area.
										7	
				30	:	9	:	2	:	5	
										3	
			Facit	92	:	3	:	7	:	3	

The Price of felling and hewing of Timber.] They have 1 *s.* and 14*d. per* Load for felling of Timber, and about 3 *s. per* Load for hewing.

How much Timber goes to a Square of Framing.] Mr. *Leybourn* tells us that 20 Foot of ſolid Timber (cut into convenient Scantlings) will compleat a *Square (i. e.* 100 Superficial Feet) of any Building great or ſmall, *i. e.* the Carcaſs, *viz.* outſide Frame, Partitions, Roof and Floors.

TONDINO [in *Architecture.*] See *Tore.*

TOP - BEAM. See *Collar-Beam.*

TORE } [in *Architecture*]
TORUS } is a thick, round Moulding, us'd in the Baſes of Columns

Columns: It is the bigneſs that diſtinguiſhes the *Torus* from the *Aſtragal.*

TORSEL. See *Taſſels.*

TRACTRIX [in *Geometry*] a curve Line, call'd alſo *Catenaria.*

TRABEATION is the ſame as *Entablement.*

TRAMMEL, an Iron moving Inſtrument in Chimneys, whereon they hang the Pot over the Fire.

TRANSMISSION [in *Opticks*,&c.] The Act of a tranſparent Body, paſſing the Rays of Light through its Subſtance, or ſuffering them to paſs, in which Senſe, the Word ſtands in Oppoſition to Reflection.

TRANSOM [in *Building*] a Piece that is fram'd croſs a double Window-light.

Mr. *Wing* ſays, Tranſom-Windows in great Buildings, are worth 6 *s.* 9 *d.* or 7 *s. per* Window.

TRANSMUTATION [in *Geometry*] is the reducing or changing one Body into another of the ſame Solidity, but of a different Figure; as a Triangle into a Square; a Pyramid into a Parallelopiped, &c.

TRANSVERSE, Going acroſs from the right to the left.

TRAPEZIUM, is a Figure having four unequal Sides and oblique Angles. See *Pl. Fig.* 3.

To find the Area or Superficial Content.

The RULE.

Add the two Perpendiculars together, and take half the Sum and multiply that half Sum by the Diagonal; or multiply the whole Sum by half the Diagonal, and the Product will be the Area, or

You may find the Area's of the two Triangles A B C, and A C D (by the Rules for Triangles) and add thoſe Area's together, and the Sum will be the Area of the *Trapezium.* See *Triangle.*

$$
\begin{array}{r}
D\ F = 30.1 \\
D\ E = 24.5 \\
\hline
\text{Sum } 54.6 \\
\hline
\text{Half } 27.3 \\
A\ C = 80.5 \\
\hline
1365 \\
2184 \\
\hline
\text{Area } 2197.65
\end{array}
$$

Let *A B C D* be a *Trapezium* given, the Diagonal of which is 80.5, and the Perpendicular *B F* 30.1, and the Perpendicular *D E* 24.5. Theſe two being added together, the Sum is 54.6. the half of which is 27.3. which multiply'd by the Diagonal 80.5, the Product will be 2197.65, which is the Area of the *Trapezium*; or

If 40.25 half the Diagonal, be multiply'd by 54.6 the whole Sum of the Perpendiculars, the Product will be 2197.65, the ſame as before.

By Scale and Compaſſes.

Extend the Compaſſes from 2 to 54.6; and that Extent will reach

reach from 80.5 to 2197.65, the Area.

Demonſtration.

This Figure *ABCD* is compos'd of two Triangles; the Triangle *ABC* is half the Parallelogram *AGHC*: alſo the Triangle *ACD* is equal to half the Parallelogram *ACIK* as is prov'd.

Wherefore the *Trapezium* *ABCD*, is equal to half the Parallelogram *GHIK*. See *Triangle*.

To find the Area $HI = BF + DE$; therefore half $HI \times AC$ ($= KI = GH$) = Area of the *Trapezium*: which was to be prov'd.

To TRAVERSE [in *Joinery*] ſignifies to plane a Board or the like, a-croſs the Grain.

TRAVERSE *Tile*. See *Tile*.

TRELLIS, an Aſſemblage or ſetting together of wooden or iron Bars, which croſs one another in a ſtrait Line or ſlopingly; the Uſe of it being for Wall-Fruit Trees. You muſt firſt cramp ſome Hooks, checkerwiſe into the Wall, three Foot diſtant from one another, leaving two Inches jutting out, to ſet the Poles or Props upon: Oak being the moſt laſting, is moſt in requeſt, provided there be no Sap in it; having gotten together a ſufficient Quantity of Props, the Carpenter muſt make them ſmooth and ſtrait, without weakening them; and place them on Hooks, one over another; the Square ought to be ſeven Inches wide and eight high; an oblong Square will be more graceful than one that is perfect; you may faſten them together with Wire, and when the *Trellis* is finiſh'd, if the Props are painted in ſome Oil Colour, it will make them laſt the longer.

There is another Sort of *Trellis* made of Iron Wire; for which ſuppoſe the Wall where you are to make it be nine Foot, your Bearers muſt be of an equal Height, fix'd in three Rows, two Foot diſtant one from another, and muſt place your Poles upon every Row, each nine Foot long, join'd together at the Ends, and faſtened to the Bearers of every Row with an Iron Wire.

Theſe Poles are to be continued the Height of the Wall, from ſix Fathom to ſix Fathom, tied to one of the Bearers of every Row; the Poles are put upon the Bearers, becauſe the Wire *Trellis* may be well tyed and faſtened.

The Squares are to be made after the Manner of thoſe of Wood; that is, ſeven Inches long, and eight high; your Expence this way, will be two thirds leſs than the other, and the Work will laſt infinitely longer.

If inſtead of Props, you made Uſe of Iron Rods, ſuch as Glaziers uſe in their Caſements, they would continue a long time ſerviceable.

TRIANGLE [in *Geometry*] is a Figure comprehended under three Lines, and which conſequently has three Angles.

If the three Lines or Sides of the *Triangle* be right, it is

ſaid

ſaid to be a *plane* or *rectilinear Triangle.*

If all the three Sides of the *Triangle* be equal, it is call'd an *equilateral Triangle.*

If only two Sides of the *Triangle* be equal to one another, it is call'd an *Iſoſceles* or *Equicrural Triangle.*

If all the Sides of the *Triangle* be *nuequal*, it is call'd a *ſcalenous Triangle.*

If one of the *Angles* of a *Triangle*, be a Right Angle, the *Triangle* is ſaid to be *rectangular.*

If one of the Angles of a *Triangle* be obtuſe, the Triangle is ſaid to be *obtuſe angular*, or *amblygonous.*

If all the Angles be acute, the *Triangle* is ſaid to be *acute angular*, or *oxygonous.*

If the three Lines of the *Triangles* be all Curves, the *Triangle* is ſaid to be *curvilinear.*

If ſome of the Sides of a *Triangle* be right, and others curve, it is ſaid to be *mixtilinear.*

TRIANGLE is a Figure having three Sides and three Angles.

To find the Superficial Content of a Triangle.

The RULE.

Let the *Triangle* be of what Kind ſoever, multiply the Baſe by half the Perpendicular, or half the Baſe by the whole Perpendicular; or multiply the whole Baſe by the whole Perpendicular, and take half the Product, any of theſe three ways will give the Content.

Let *ABC* be a right angled *Triangle*, whoſe Baſe is 14.1 Feet, and the Perpendicular 12 Feet; multiply 14.1 by 6, half the Perpendicular, and the Product will be 84.6 Feet, the Content: or,

Multiply 14.1 by 12, the Product will be 169.2, the half of which is 84.6, the ſame as before. *Fig.* 4.

14.1 Baſe
6 half Perpendicular
———
84.6 Product

14.1 Baſe
12 Perpendicular
———
169.2 Product
———
84.6 half

By Scale and Compaſſes.

Extend the Compaſſes from 2 to 14.1, that Extent will reach the ſame way from 12 to 84.6 Feet, the Content.

15.4 Baſe.
3.9 half Perpendicular.
———
1386
462
———
60.06 Product.

15.4 Base	7.7 half Base.
7.8 Perpendicular	7.8 Perpendicular
1232	616
1078	539
120.12	60.06
60.06	

Let *ABC* (Figure 5) be an oblique-angled Triangle given, whose Base is 15.4, and the Perpendicular 7.8. If 15.4 be multiply'd by 3.9 (half the Perpendicular) the Product will be 60.06 for the Area or Superficial Content: Or if the Perpendicular 7.8 be multiply'd into half the Base, 7.7, the Product will be 60.06 as before: Or if the whole Perpendicular 7.8, the Product will be 120.12 which is the double Area; the half of which is 60.06 Feet, as before.

By Scale and Compasses.

Extend the Compasses from 2 to 15.4, that Extent will reach from 7.8 to 60.06 Feet, the Content.

Demonstration.

If *AD* (Fig. 4.) be drawn parallel to *BC*, and *DC* parallel to *AB*; the Triangle *ABC* shall be equal to the given Triangle *ADC*.

Hence the Parallelogram *ABCD* is double to the Triangle given; therefore half the Area of the Parallelogram is the Area of the Triangle.

In Figure 5. the Parallelogram *ABEF*, is also double to the Triangle *ABC*, for the Triangle *ACF* is equal to the Triangle *ACD*, and the Triangle *BCE* is equal to the Triangle *BCD*; therefore the Area of the Parallelogram is double to the Area of the given Triangle, which was to be prov'd.

To find the Area of any Plain Triangle, by having the three Sides given, without the Help of a Perpendicular.

The RULE.

Add the three Sides together, and take half that Sum; then subtract each Side severally from that half Sum. This being done, multiply that half Sum and the three Differences continually, and out of the last Product extract the *Square* Root, which Square Root shall be the Area of the Triangle sought.

Example. Let *ABC Fig.* 6. be a Triangle, whose three Sides are as follows, *viz. AB*, 43.3. *AC.* 20.5 and *BC* 31.2, the Area is required.

 Sides

Sides	43.3	4.2	Differences.
	31.2	16.3	
	20.5	27.0	

Sum 95.0

Area 296.31. 47.5 half Sum.
27 Difference.

3325
950

1282.5 Product.
16 3 Difference.

38475
76950
12825

20904.75 Product.
4.2 Difference.

4180950
8361900

8799.9500

87799.9500(296.31
4

49)477
441

586)3699
3516

5923)18395
17769

59261)52600
59261

3339 Remains.

Demon-

Demonstration.

In the Triangle BCD, *Fig.* 7. if from the half Sum of the Sides you subtract each particular Side, and multiply the half Sum and the three Differences together, the square Root of the Product shall be the Area of the Triangle.

First, By the Lines B I, C I, and D I, bissect the three Angles, which Lines will all meet in the Point I; by which Lines the given Triangle is divided into three new Angles C B I, D C I, and B D I; the Perpendiculars of which new Triangles, are the Lines A I, E I and O I, being all equal to one another; because the Point I is the Centre of the inscrib'd Circle, (by *Euclid. Lib. IV. Prop.* 4.) wherefore to the Side B C, join C F equal to D E or D O; so shall B F be equal to half the Sum of the Sides, *viz.* $= \frac{1}{2}$ B C $+ \frac{1}{2}$ B D $+ \frac{1}{2}$ C D.

And B A = B F − C D, for C A = C O and O D = C F therefore C D = A F and A C = B F − B D for B E = B A and E D = C F: Therefore B D = B A + C F and C F = B F — B C.

Then make C K = C F and draw the Perpendiculars F H, G H, and K H, and extend B I to H; because the Angles F C K more F H K are equal to two Right Angles (for the Angles F and K are Right Angles) equal also to F C K + A C O (by *Euclid* 1. 13.)

And the Angles A C O + A I O are equal to two Right Angles; therefore the Quadrangles F C K H, and A I O C are alike; and the Triangles C F H, and A I C are also similar; and the Triangles B A I, and B F H are also similar.

From this Explanation it appears that the Square of the Area of the given Triangle will be B F q x I A q = B F x B A x C A x C F. In Words

The Square of B F (the half Sum of the Sides) multiply'd into the Square of I A (= I F = I O) will be equal to the said half Sum multiply'd into all the three Differences.

For I A : B A : : F H : B F, and I A : C F : : A C : F H; because the Triangles are similar. By *Euclid, Lib. VI. Prop.* 4.

Wherefore multiplying the Extreams and Means in both, it will be I A q x B F x F H = B A x C A x C F x F H; but F H being on both Sides of the Equation, it may be rejected; and then multiply each Part by B F q x I A q = B F x B A x C A x C F: which was to be demonstrated. See the *Plate*.

TRIANGULAR *Compasses* are such as have three Legs or Feet, whereby to take off any Triangle at once.

TRIANGULAR *Numbers* are a kind of Polygonous Numbers; being the Sums of Arithmetical Progressions, the Difference of whose Terms is 1: thus

1	2	3	4	5	6
1	3	6	10	15	21

TRIDENT [with *Mathematicians*] is us'd for a kind of Parabola, by which *Cartes* constructed Equations of six Dimensions.

TRIGLYPHS [in *Architecture*] a Sort of Ornament repeated at equal Intervals in the *Doric* Freeze; or they are a kind of Steps (in the *Doric* Freeze) between the Metopes.

TRIGLYPHS. The ordinary Proportion of them is one Module in Breadth, and one and a half in Height. But in Regard these Measures occasion a Disproportion in the Intercolumniations of Portico's (a thing particularly observable in *Vignola*, who makes the Pillars there five Modules broad.) M. *Le Clerc* accommodates the Proportion of his, *i. e.* the Triglyphs, to that of the Intercolumniations; thinking it more reasonable to make the little Parts correspond to the greater, than the greater to the less; and yet is of Opinion, that his Triglyphs, tho' different from the ordinary ones, are not inferior to them in Beauty.

When the *Triglyphs* and *Metopes* follow each other regularly, the Columns must only stand one by one; excepting those of the inner Angles, which ought always to be accompanied with two others, one on each Side; from which the rest of the Columns may be plac'd at equal Distances from each other; and it is to be observ'd, that these two Columns, which accompany that of the Angle, are not less necessary, on Account of the Solidity of the Building, than of the regularity of the Intercolumniations.

TRIGON [in *Geometry*] a Triangle.

TRIGONOMETRY, is the Art of finding the Dimensions of the Parts of the Triangle unknown, from other Parts known: Or it is the Art whereby from any 3 Parts of a Triangle given, to find the three other Parts.

Plain TRIGONOMETRY, is the Art whereby, from any three given Parts of a plain Triangle, we find all the rest.

Thus, e. g. from two Sides A B *and* A C, *and an Angle* B, *we find by* TRIGONOMETRY, *the other Angles* B *and* C, *with the third Side* B C. *Plate, Fig.* 1.

A *Chord* of an Arch or Angle, is a right Line A B, dividing the whole Circle into two Parts, and subtends both Segments. *Fig.* 2.

Hence, the greatest Chord that can be drawn in a Circle, is the Diameter.

Hence also, all the Chords of Arches, greater than a Semicircle, are less than the Diameter.

A *right Sine* A D, of the Arch A E or A I, is one half of the Chord A B of the double Arch A E B or A I B.

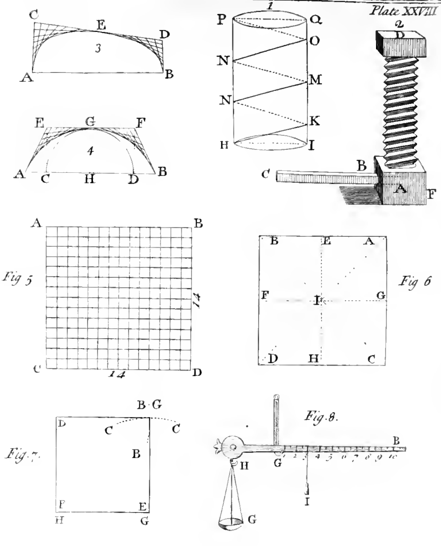
Hence, the Sine A D *is perpendicular to the Radius* E C, *consequently, all Sines standing upon the same Radius, are parallel between themselves.*

A *whole Sine*, is the Radius H C, or the Sine of the Quadrant H E.

A *versed Sine*, is that Part of the Radius E D, or D I, intercepted betwixt the right Sine A D, and the Arch A E or A I.

Hence, the greatest versed Sine, is the Diameter E I.

Since


1
2
3
4
Fig 5
Fig 6
Fig. 7.
Fig. 8.
14
14
1 2 3 4 5 6 7 8 9 10

Since that the Arch A E *is the Measure of the Angle* ACE, *and* A I *is the Measure of its contiguous Angle* A C I; *but the Quadrant* H E *is the Measure of a Right Angle;* A D *will also be the right Sine, and* E D *the versed Sine of the Angles* ACE *and* ACI; *but the whole Sine is the Sine of a right Angle.*

Therefore two Angles, which are adjacent, have the same Sine. Likewise obtuse Angles have the same Sines, which their Complements have to two right ones.

A *Tangent* of an Arch A E is a right Line, E F touching the Circumference of the Circle, and is at right Angles to the Diameter E I, and limited by F C, called the Secant of the same Arch.

F E *is also the Tangent, and* F C *the Secant of the Angle* A C E, *and also of the Angle* A C I.

Therefore two adjacent Angles have the same Tangent and Secant.

The *Cosine*, is the Sine A G, the *Cotangent* F H is the Tangent, and the *Cosecant* F C is the Secant of the Arch A H, which is the Complement of the other Arch A E to a Quadrant.

The Complement of an Arch or Angle, is what it wants of a Quadrant, a Semicircle, or of a whole Circle. Thus 20 *Degrees is the Complement of* 70 *Degrees to a Quadrant; because* 20 *Degrees is the Remainder of* 70 *Degrees subtracted from* 90 *Degrees: Also,* 50 *Degrees is the Complement of* 130 *to* 180 *Degrees, and* 70 *the Complement if* 290 *to* 360 *Degrees.*

The Radius C A, with the Sine A D and Cosine D C, make a Triangle C A D, similar to the Triangle C F E made by the Radius C E, Tangent E F, and Secant C F. Likewise the Radius, Cotangent and Cosecant, make another Triangle, similar to the two former.

Hence as the Cosine is to the Sine, so is the Radius to the Tangent. That is, as CD : A : : CA : E F.

As the Radius is to the Sine, so is the Secant to the Tangent. That is, as C A : A D : : C F : F E.

As the Sine is to the Radius, so is the Radius to the Cosecant. That is, as D A : C A : : H C : CF.

As the Tangent is to the Radius, so is the Radius to the Cotangent. That is, as F E : E C : : C H : F H.

Therefore the Rectangle, between the Tangent and Cotangent of any Arch, is equal to the Square of the Radius.

When a Triangle is given to be resolv'd, first, we are to consider, that there is in the Table of *Logarithms*, Sines, Tangents, and Secants, a Triangle exactly similar and equal to that which is to be solved, and whose Sides are to one another in the same Proportion of those of the Triangles proposed.

Next, we must understand whatever *Ratio* one Side of the given Triangle has to the other Side about the same Angle, consi-

confidered as Lengths, eftimated or numbred by any known Meafure: As fuppofe, Inches, Yards, Miles, &c. the very fame has the two Sides about the fame Angle, in the Triangles in the Tables, or in the tabular Parts; which two things, well underftood, will lead us into the whole Myftery of Trigonometrical Calculations.

In eftimating the Quantity of Sines, &c. *we affume Radius for Unity; and determine the Quantity of Sines, Tangents and Secants in Fractions thereof. From* Ptolomy's Almageft, *we learn, that the Ancients divided the Radius into 60 Parts, which they called Degrees; and thence determined the Chords in Minutes, Seconds and Thirds; that is, in fexagefimal Fractions of the Radius, which they likewife ufed in refolving Triangles. The Sines or half Chords, were firft ufed by the* Saracens. Regiomontanus, *firft, with the Ancients, divided the Radius into fixty Degrees, and determined the Sines of feveral Degrees in decimal Fractions thereof. But he afterwards found it would be more commodious to affume Radius for one; and thus introduced the prefent Method into* Trigonometry. *In common Tables of Sines and Tangents, the Radius is fuppofed to be divided into* 10,000,000 *Parts, beyond which we never go in determining the Quantity of Sines and Tangents. Hence, as the Sine of a Hexagon fubtends the fixth Part of a Circle, and is equal to the Radius, the Sine of* 30 *Degrees, is* 5,000,000.

Trigonometrical Problems.

PROB. I.

The Sine A D *being given, to find the Cofine, or Sine Complement,* A G. See *Pl. Fig.* 2.

Becaufe that E C, the Sine of the fame Arch E H, is perpendicular to H C and A G; the Sine of the Arch A H is perpendicular to the fame HC; A G will be parallel to D C, and the Angle A G C a right Angle, and fo A G C will be a right angled Triangle. Wherefore, feeing A D and H C are perpendicular to E C; G C will be equal to A D. If therefore from the Square of the Radius A C be fubtracted the Square of the Sine A D, or G C, the Remainder will be the Square of the Cofine A G. Whence if the fquare Root be extracted, it will give the Cofine A G. *e. g.* Let A C be 10,000,000, A D 5,000,000, A G will be 8,660,254, the Sine of 60 Degrees.

PROB. II.

The Sine A D *of the Arch* A E *being given, to find the Sine of half that Arch. Fig.* 2.

Find the Chord of the Arch A E; for half of this is its Sine. Thus, *e. g.* D G and A D, as in the preceeding Problem, we fhall find the Sine of half the Arch A E, or the Sine of 15 Degrees = 2,588,190.

PROB. III.

The Sine D G *of the Arch*

D F

DF *being given, to find the Sine* DE *of the double Arch* DB. *Fig.* 3.

Since the Angles at E and G are right Angles, and the Angle B is common to both Triangles, BCG and DEB; BC : CG :: BD : DE. Wherefore CG being found by the second Problem, and BD being double of DG; DE is found by the Rule of Proportion.

Hence, CB : 2 CG :: BD : 2 DE, *that is, the Radius is double to the Cosine of one half of the Arch* DB, *as the Subtense of the Arch* DB *is to the Subtense of double the Arch. Also, as* CB : 2 CG :: | 2 BG : 2 DE :: | BG : DE :: ½ CB : CG. *Wherefore, the Sine of any Arch, and the Sine of its Double being given, the Cosine of the Arch it self is given.*

PROB. IV.

The Sines FG *and* DE *of the Arches* FA *and* DA, *whose Difference* DF *is not greater than* 45 *Minutes, being given, to find any intermediate Sine, as* IL. *Fig.* 4.

To the Difference FD of the Arches, whose Sines are given; the Difference of the Arch IF, whose Sine is required, and the Difference of the given Sines DH, find a fourth Proportional: This added to the less given Sine FG, the Aggregate will be the Sine required.

PROB. V.

The Sines BD *and* EF *of the two Arches* AB *and* AF, *being given, to find the Sine* BF *of the Arch of half the Difference.*

Subtract the lesser Sine BD from the greater EF, and the Remainder will be FK. From the given Sines BD and EF, find the Cosines BI and FH, by Problem I, subtract the lesser Cosine FH from the greater BI, the Difference will be BK. Extract the square Root from the Sum of the Difference of the Squares, the Remainder will be BF, the half of which is the Sine sought.

PROB. VI.

To find the Sine of 45 *Degrees. Fig.* 2.

Let HI be a Quadrant of the Circle, then will HCI be a Right Angle; consequently the Triangle, rectangular: Therefore $HI^2 = HC^2 + CI^2 = HC^2$; wherefore, since HC the whole Sine, is 10,000,000; if from 2 HC^2 squared 200,000.000,000,000 be extracted, the square Root 14,142,136, the Chord HI will be the Remainder, whose half 7,071,068, the Sine of 45 Degrees required.

THEOREM VII.

In small Arches, the Sines and Tangents of the same Arches are nearly to one another, in a Ratio of Equality. Fig. 5.

The Triangles CED and CBG being equiangular, CE : CB :: ED : BG; but as the Point E approaches B, EB will vanish in respect of the Arch BD.

B D. Whence CE will become nearly equal to C B. and so E D will also be nearly equal to EG. If EB be less than the $\frac{1}{10\,000\,000\,000}$ of the Radius, then the Difference between the Sine and the Tangent will also be less than the $\frac{1}{10\,000\,000\,000}$ Part of the Tangent.

Since any Arch is less than the Tangent, and greater than its Sine, and the Sine and Tangent of a very small Arch, are nearly equal, it follows, that the Arch will be nearly equal to its Sine; and so in very small Arches it will be, as Arch is to Arch, so is Sine to Sine.

PROB. VIII.

The Sine of one Minute or 60″ F G *being given, to find the Sine of one or more Seconds* M N. *Fig.* 4.

Since the Arches A M and A F are very small, A M F may be taken for a right Line, without any sensible Error in the Decimal Fractions of the Radius, wherein the Sine is expressed; that is, the Arches A M and A F, may be taken proportional to their Chords. Wherefore, since M N is parallel to FG: A F : F G : : A M : M N. Therefore A F, F G and A M being given, M N is easily had.

PROB. IX.

To find the Sine of the Arch of one Minute.

The Subtense of 60 Degrees is equal to the Radius, so the half of the Radius will be the Sine of the Arch of 30 Degrees. Wherefore, the Sine of the Arch of 30 Degrees being given, the Sine of the Arch of 15 Degrees may be found (by Prob. II.) and so on till twelve Bisections being made, we come to an Arch of 52², 44³, 03⁴. 45⁵, whose Cosine is near equal to the Radius, in which Case the Arches are proportional to their Sines: And so, as the Arch 52², 42³, 03⁴, 45⁵, is to an Arch of one Minute, so shall the Sine before found, be to the Sine of one Minute; and when the Sine of one Minute is found, then the Sine and Cosine of two Minutes will be had.

PROB. X.

The Sine A D *of the Arch* A E, *being given, to find the Tangent* E F, *and the Secant* F C *of the same Arch. Fig.* 2.

Because the Sine A D, and Tangent E F are perpendicular to the Radius E C, A D will be parallel to E F: Wherefore, as the Cosine D C is to the Sine A D, so is the whole Sine to the Tangent E F: Also, as the Cosine D C is to the whole Sine A C, so is the whole Sine E C to the Secant C F.

PROB. XI.

To construct a Canon of Sines.

The Sines of 30°, 15°, 45° and 36°, (which we have already shewn how to find) being had, we can thence construct a Canon of all the Sines to every Minute, or even a Second. For from the Sine of 36°, we find those of 18°, 9°, 4° 30 and 2° 15 (by

(by Prob. II.) the Sines of 54°, 72°, 81°, 85° 30 and 87°45, &c. (by Prob. I.) Again, for the Sine of 45° find the Sine 22°30, 11°15, &c. From the Sines of 30° and the Sines of 54° find the Sine of 12°. From the Sine of 12°, find the Sines of 6°, 3°, 1°30, 4578°, &c. From the Sine of 15° find the Sine of 7°30 30°45, &c. till you have 120 Sines, succeeding each other orderly at an Interval of 45 Minutes. Between these find the intermediate Sines (by Prob. V.) Thus will the Canon be compleat.

PROB. XII.
To find the Logarithms of any given Number.

The first Page of the annexed *Tables of Logarithms* contains all the natural Numbers in their proper| Order, from 1 to 100. And against every one of these Numbers, is plac'd its *Logarithm*, with its *Index* before it.---Thus against the Number 28, its Log. is 1.447158; and against the Number 89, its Log. is 1.949390: and so on for the rest. In the first Column of all the following Pages, under *Num.* the natural Numbers proceed in their due Order, from 100 to 1000. And in the next Column, under 0, against every one of these Numbers, is the decimal Part of its Logarithm, without any Index; to which its proper Index must be prefixed, according as the natural Number used requires, *e. g.* against the Number 856, under 0, is 932474; to which if 2 the Index of 856 be prefixed, it will be 2.932474, the compleat Logarithm of 856.

The other five Columns of each Page, contain the Logarithms of all Numbers, from 1000 to 10000. Those in the Left-hand Pages are distinguished on the Top of the Columns with the Figures 0.1.2. 3.4, and those in the Right-hand Pages with 5.6.7.8.9. So that to find the Logarithm of any Number between 1,000 and 10,000, as suppose of 5.468 seek for the three first Figures, *viz.* 546, in the first Column under *Num.* and for the last Figure, *viz.* 8, at the Top. Then in the Column under the last Figure 8, and over against the three first Figures 546, there is 737829; to which if 3, the Index of 5.468, be prefixed, the compleat Logarithm thereof will be 3.737829; and so for any other Logarithm of any proposed Number, not exceeding 10,000. But if the proposed Number be above 10,000, *which is the Limits of the annexed Table*, then the Logarithm of that Number must be found, by the Help of the *common Difference* of the Logarithms, which is the last Column of every Page under *Diff.* Thus:

Find the Logarithms of the first four Figures of the given Number, without its Index, as above; and multiply the common Difference which stands against the Logarithm, under Diff. *with the other Figures of the given Number, casting off so many Figures of that Product*

as

as there are in the Multiplicator; then add the remaining Figures of that Product to the Logarithm of the first four Figures, and to their Sum prefix the proper Index; and you will have the compleat Logarithm required.

Suppose it were required to find the Logarithm of 698,476. First, the Logarithm of 6,984 is found in the Table, as above, to be 844,104 and against it, under *Diff.* is 62. This 62 being multiplied with 76, the other two Figures of the given Number, produces 4.712. Cut off 12, *viz*, the two last Figures, and then add 47 to the Logarithm last found, and the Sum will be 844,151; to which prefixing 5, the proper Index of the given Number 698,476, it will be 5.844,151, the Logarithm required.

PROB. XIII.
To find the Number to any given Logarithm.

Omit the Index of the given Logarithm, and then seek it in the Table of Logarithms, and if exactly found there, then the Number in the first Column under *Num.* with that on the Top, over Logarithm, will be the Number required. But if the given Logarithm without its Index, cannot be exactly found in the Table, then the proper Number agreeing to that Logarithm may be found by the Help of the common Difference of Logarithms: Thus:

From the given Logarithm subtract the next less, and to the Remainder annex Cyphers; then divide it by the common Difference found against the next Logarithm, under Diff: *and the Quotient will be a Number that must be annex'd to the Number already found against the next less Logarithm, according as the Index of the given Logarithm denotes.*

Suppose, 5.660279 were a given Logarithm, and it were required to find the natural Number answering it.

The Number sought, must consist of six Places of Figures in whole Numbers, as appears by its Index 5; which being omitted, seek in the Table of Logarithms for 660279; but not finding it exactly there, take the next less to it, *viz.* 660201 standing under 3. and against 547: Therefore the first four Figures of the Number sought must be 4,573, and the common Difference found against 660201, under *Diff.* is 95.

Then for the Logarithm	660279
Subt. the next less, *viz.*	660201
Remains	78

To which annex two Cyphers, because there is yet wanting two Places of Figures, and it will be 7,800, which being divided by the common Difference 95, the Quotient will be 82, which must be annexed to 4.573, and the Sum will be 457,382, the Number answering to the given Logarithm 5.660279. Thus the Logarithm of any given Number may

may be easily found, altho' it exceeds the Limits of the Table by 1,203 Places of Figures, and also the Number agreeing to any given Logarithm, without the Help of such a Table of proportional Parts, as is usually inserted along with the Table of Logarithms for that Purpose.

PROB. XIV.

Having given a short Description of Sines, Tangents, *&c.* we shall here shew the Geometrical Construction of those and other Scales commonly used in projecting the Sphere in Plano and in Trigonometry, Navigation, Dialling, and other Parts of practical Mathematicks, as they are deduced from a Circle. *Fig.* 6.

Upon a Sheet of fine Pasteboard, or such like Matter, describe a Circle ABDC with any Radius, which cross at right Angles with the Diameters A B and CD; then continue AD to G, and upon the Point B raise B F perpendicular to CB. Draw the Chord AB, and divide the Quadrant A B into nine equal Parts, setting the Figures 10, 20, 30, *&c.* to 90; each of which nine Parts again subdivide into 10 equal Parts, and then the Quadrant will be divided into 90 Degrees. Set one Foot of the Compasses in the Point A, transfer the said Divisions to the Chord Line AB, and set thereto the Figures 10, 20, 30, *&c.* and the Line of Chords AB will be divided.

To project the *Sines*, divide the Arch B D into 90 Degrees; from each of which Degrees, let fall Perpendiculars on the Semi-Diameter E B, which Perpendiculars will divide E B into a Line of Sines, to which set the Numbers 10, 20, *&c.*

To project the *Line of Tangents*, from the Centre E, and thro' every Division of the Arch BD, draw the right Lines cutting B F, which will divide it into a Line of Tangents, set thereto the Numbers 10, 20, *&c.*

To project the *Line of Secants*, transfer the Distances E 10, E 20, *&c.* from the Tangent Line, upon the Line EG, and set thereto the Numbers 10, 20, *&c.* The Line EG will be divided into Line of Secants.

To project the *Semi-tangents*, draw Lines from the Point C thro' every Degree of a Quadrant AB, and they will divide the Semi-diameter A E into a Line of Semi-tangents; but because the Semi-tangents on Scales run to 160 Degrees, continue the Line AE, and draw Lines from the Point C thro' the Degrees of the Quadrant CA, cutting AE, and you will have the Line of Semi-tangents to 160 Degrees, *&c.*

To project the *Rhumb line*, from every eighth Part of the Quadrant AC, set one Foot of the Compasses in A, describe an Arch cutting the Chord AC, which will divide AC into a Line of whole Rhumbs.

To project the *Line of Longitude*, draw HD equal and parallel to the Radius CE, which divide

divide into 60 equal Parts, every 10 of which, number. Now from every one of these Parts let fall Perpendiculars to CE, cutting the Arch CD; and having drawn the Chord CD, with one Foot of the Compasses in D, transfer the Distances from D to each of the Points in the Arch CD on the Chord CD, and set thereto the Numbers 10, 20, *&c.* and the Line of Longitude will be divided.

These are all the Lines commonly put upon one Side of the Plain Scale, except equal Parts, which want no Description: And on the other Side is a Decimal or Diagonal Scale, on which an Inch, or some Part thereof, as $\frac{1}{2}$ or $\frac{1}{4}$ is divided into 100 equal Parts, by Diagonals.

Of the Uses of the Chords, Sines and Tangents, &c. *upon the Rule.*

The Chords are to lay off the Quantity of an Angle desired upon a given Point in a right Line, and to measure the Quantity of an Angle already laid down. The first is done, by taking the Extent of 60 Degrees of Chords between the Compasses, and describing an Arch about the angular Point; then laying off the Number of Degrees proposed, upon the said Arch, and drawing a right Line from the angular Point. And the latter, by making an Arch of 60 Degrees of Chords about the angular Points, and then taking the Chord of the said Arch, between the Compasses, and measuring it on the Line of Chords.

Example. To make an Angle of 30 Degrees on the Point A, Take 60 Degrees of Chords in the Compasses, and setting one Foot in A, describe the Arch DC; then take off 30 Degrees from the Chords, lay them off from D to C, and draw the Line AC. The Angle CAB will be 30 Degrees, *Fig.* 7.

To measure an Angle, suppose CAB. Take 60 Degrees of Chords, between the Compasses, and casting one Foot in A, describe the Arch CD; then take the Distance from C to D; which, measured on the Chords, will reach to 30 Degrees, the Quantity of the Angle sought.

The Sines are to project the Sphere orthographically, *&c.*

The Tangents, Half-Tangents and Secants, are used in finding the Centers and Poles of projected Circles in the Stereographical Projection of the Sphere, *&c.*

The Rhumbs, are to lay down the Angles of a Ship's Way in Navigation.

And the Line of Longitude determines, by Inspection, how many Miles there are in a Degree of Longitude, in each several Latitude, as in the Latitude of no Degrees, that is under the Equator, 60 Miles make a Degree; in the Latitude of 40 Degrees, 46 Miles make a Degree, in the Latitude of 60 Degrees, 30 Miles make a Degree; in the Latitude of 80 Degrees, 10 Miles make a Degree.

Having thus laid the Foundation, we shall next shew the Resolution of all right lined Tri-

Fig. 4. Plate *

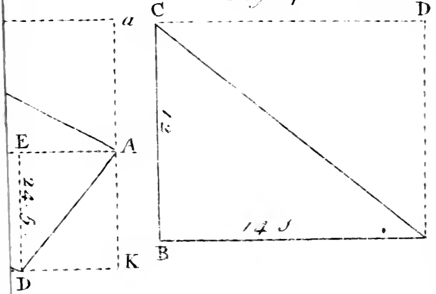
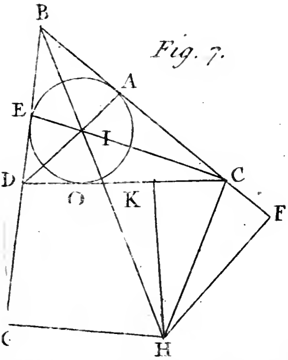


Fig. 7.



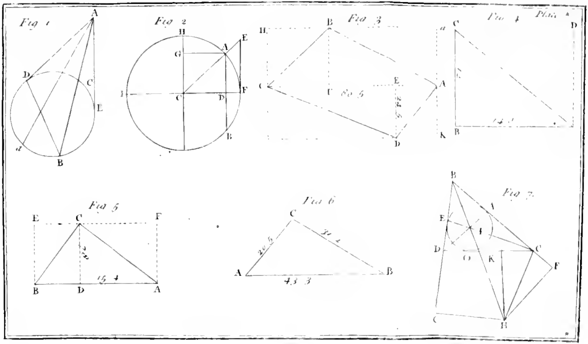


Fig 1
Fig 2
Fig 3
Fig 4
Fig 5
Fig 6
Fig 7
43 3

Triangles in as plain and familiar Method as possible.

Of resolving TRIANGLES.

THEOREM I.

In any right-angled Triangle if either of the Legs be made Radius, the other Leg will be the Tangent of its opposite Angle, *e.g.* If AD be made Radius, BD will be Tangent of the Arch d D = BAD; and if BD be made Radius, AD will be Tangent of the Angle B. But if the Hypothenuse AB be made Radius, the Legs BD and DA will be the Sines of their opposite Angles A and B. *Fig.* 8.

THEOREM II.

The Sides of every right-lined Triangle are in proportion to one another, as the Sines of their opposite Angles.

In the Triangle ABC make AF = BC, and let fall the Perpendiculars from F and B to the Side AC, describe the Arches HB and FI. Then B D will be the Sine of the Angle at C, and FE the Sine of the Angle at A, and the Triangles A B D and AFE are similar. Therefore, AF : AB : : FE : BD, or as AB : BD : : A F : F E, and A F being equal to B C, and the two Perpendiculars being Sines, it will be, as the Side B C : Side B A : : Sine of the Angle A : Sine of the Angle C; as the Side A B : Sine of the Angle C : : Side B C: Sine of the Angle A. *Fig.* 9.

THEOREM III.

As the Sum of the Legs about an Angle, is to their Difference; so is the Tangent of half the Sum of the opposite Angles, to the Tangent of half their Difference.

Produce, in the Triangle C F D, the Side F D, and make B F = C F; then B D will be the Sum of the Legs, and G D half the Sum; if you take from which the Leg F D, the Remainder G F = $\frac{1}{2}$ the Difference of the Legs; draw C B and bisect it in A, and draw A F, which will be perpendicular to it, and the Angle C A F = the Angle B F A, (by Prop. 8. *Euclid.* l. 1.) but the Angle C F B = the Angle F C D + the Angle D: (by Prop. 32. *Euclid. l.* 1.) Therefore the Angle C F A = $\frac{1}{2}$ the Sum of the Angles F C D + D; draw A G, which will be parallel to C D, because the Sides C B and B D are bisected in A and G; then draw E F parallel to C D, which will be parallel to A G; the Angle C F E = the alternate Angle F C D, the lesser Angle of the Triangle, because the Angle C F E = the Angles C + D and E F B = the Angle D, take from both the Angle D, then C F E = the Angle C, which taken from the Angle C F A = $\frac{1}{2}$ the Sum of the opposite Angles, leaves E F A = $\frac{1}{2}$ the Difference of the opposite Angles. Now make A F Radius of a Circle, then E A is the Tangent of half the Difference, and A C the Tangent of half the Sum of the opposite Angles: and the Triangles B A G, B E F and B C D are similar, (by Prop. 2. *Euclid.* l. 6.) and consequently the Sides are proportional. Therefore,

$$BG : GD :: BA : AC$$
$$BG : GF :: BA : AE$$

Therefore, as GD, half the Sum of the Sides, is to GF Half their Difference; so is AC, the Tangent of half the Sum of the opposite Angles, to AE the Tangent of half their Difference.

But the Wholes are as their Halves: Therefore the Sum of the Sides is to their Difference, as the Tangent of half the Sum of the opposite Angles, is to the Tangent of half their Difference. *Fig.* 10.

THEOREM IV.

In any Triangle whatsoever, as ACB, *the Square of the Side* AB *opposite to an acute Angle* C, *is exceeded by the Squares of the other Sides,* AC *and* CB *by the Rectangle* BCF *twice taken; which Rectangle is contained under* BC, *one of the Sides comprehending the acute Angle* C *and the Line* FC, *intercepted between the Perpendiculars* AF, *let fall upon the Side* BC *from its opposite Angle* A, *and the acute Angle* C.

The Square of BC = 2 Rectangles BFC and FC + FB². And AC² = CF² + FA² (by Prop. 47. *Euclid.* l. 1.) Wherefore, BC² + AC² = 2 BFC² + BF² + 2 FC² + AF². But 2 BFC + 2 FC² = 2 BCF. Therefore this being substituted for them; BC² + AC² = 2 BCF + BF² + AF. But AF² + BF² = AB² (by Prop. 47. *Euclid, l.* 1.) Therefore this being substituted for them, BC² + AC² = 2 BCF + AB². That is, BC² + AC² exceed AB² by 2 BCF. *Fig.* 11.

The Theorem is true, altho' the Perpendicular fall without the Triangle. And the Demonstration is almost the same. For AC² = BA² + CB² + 2 CBF. Add on both Sides, CB², then AC² + CB² = AB² + CB² + 2 CBF = AB² + 2 BCF. *Fig.* 12.

From this Theorem, and the 47*th Prop.* Euclid. l. 1. *we have the Measure of any Triangle whatsoever, whose three Sides are known, altho' the Area be altogether inaccessible. For by the Help of these Theorems the Perpendicular is known, altho' the Impediments of the Place should not allow us to mark it out. But note, That the Perpendicular, multiplied by half the Side on which it falls, produces the Area of the Triangle.*

Let there be any Triangle, as ABC, *having its Sides known. It is required, to find the Perpendicular* AF *falling from the Angle* A *upon the opposite Side* BC. *Take the Square of the Side* AB, *opposite to the acute Angle* C, *out of the Sum of the Squares* AC *and* BC: *By the last Theorem, the Remainder shall be the Rectangle* BCF *twice taken. Divide half of the Remainder, that is, the Rectangle* BCF, *by the known Side* BC; *thence will arise the right Line* CF. *Take the Square of the Line* CF, *out of the Square of* AC: *The Remainder will give the Square of* AF, *whose square Root will give the Perpendicular* AF. *Fig.* 12.

CASE

CASE I.

The two acute Angles B *and* C, *and the Base* B A, *being given, to find the Perpendicular* C A.

1. By making the Hypothenuse B C Radius.

As the Sine of the Angle C at the Perpendicular 56°15′	9.9198464
Is to the Base AB 121.394	2.0841992
So is the Sine of the Angle B at the Base 33°45′	9.7447390
	11.8289382
To the Perpendicular AC 81.113	1.9090918

2. By making the Base AB Radius. *Fig.* 13.

As Radius AB 45° - - -	10.0000000
Is to the Base BA 121.394	2.0841992
So is the Tangent of the Angle B 33°45′	9.8248926
To the Perpendicular AC 81.113	1.9090918

3. By making the Perpendicular AC Radius. *Fig.* 14.

As the Tangent BA of the Angle C at the Perpendicular 56°15′	10.1751074
Is to the Radius AC 45°	10.0000000
So is the Base AB 121.394	2.0821992
To the Perpendicular AC 81.113	1.9090918

In making the Proportions for finding the Sides or Angles of a plain Triangle, it must be observed, that every Side of a plain Triangle has two Names, and that each Side has one of those Names fixed, *viz.* the *Hypothenuse*, the *Perpendicular* and *Base*. The other Names are precarious, according to the Side made Radius, and are called the Words on the several Sides: Thus, when the Hypothenuse is made Radius, then the Word or the Hypothenuse is Radius, and the Word on the Base is the Sine of its opposite Angle; as also, the Word on the Perpendicular is the Sine of its opposite Angle; but when the Perpendicular is made Radius, then the Word on the Base is the Tangent of its opposite Angle, and the Word on the Hypothenuse is the Secant of the same Angle; and when the Base is made Radius, then the Word on the Perpendicular is the Tangent of its opposite Angle, and the Word on the Hypothenuse is the Secant of that Angle. These Things being observed, the Way to form a Proportion to find the Side of a Triangle, is thus:

First, Suppose one Side of a

Triangle to be made Radius, and obſerve, as above, the Word on the ſeveral Sides, the Proportion will be,

As the Word on the Side given,
Is to the given Side;
So is the Word on the Side required,
To the Side required.

Thus we ſee that what is ſought muſt always ſtand in the fourth or laſt Place, and therefore, ſince the Perpendicular is ſought, that muſt be the laſt of the four Terms; place it then with a Point of Interrogation after it, to ſhew it is required.

In the Rule of Proportion, the ſecond and fourth Term being always of the ſame Nature, and the Perpendicular being a Length ſought, and the Baſe the only Length given, the Baſe therefore muſt be in the ſecond Place, and is to be wrote with four Points after it thus :: to ſhew that the Proportion disjoins there.

Again, we are here to obſerve, that the Nature of Logarithms, or their Proportion to one another, is ſuch, that Addition ſerves inſtead of Multiplication, and Subtraction for Diviſion: therefore the Logarithms of the two laſt Terms being added together, and from the Sum, the Logarithm of the firſt Term being ſubtracted, the Remainder 1.9090918 will be the Logarithm of the fourth Term, and the Number anſwering to that Logarithm is 81.113, which is the Perpendicular A C required.

But where Radius is not in Proportion, it may be more readily done by Addition only; for, if inſtead of the firſt Term you ſet its arithmetical Complement, that is, to write down what each Figure wants of 9; thus the arithmetical Complement of 99198464, the firſt Term is 0.0801536, which is the ſame as ſubtracting it from 10, then add all the three Terms together, the Sum, abating the Radius, ſhall anſwer the Queſtion.

2. To do the ſame by *Scale* and *Compaſſes*. Always extend the Compaſſes from the firſt Term to the Term that is of the ſame Kind, whether it be the ſecond or third, that Extent will reach from the remaining Term to the Anſwer. Thus, in the firſt Proportion, extend the Compaſſes from 56°15′ to 33°45′ in the Line of Sines; that Extent will reach in the Line of Numbers from 121.39 to 81.11 the Anſwer. In the ſecond Proportion, extend the Compaſſes from 45° to 33°45′ in the Line of Tangents; that Extent will reach from 121.39 to 81.11 in the Line of Numbers. In ſome Caſes it may be needful to uſe Croſs-work, that is, to extend from the firſt Term in the Line of Sines, to the ſecond in the Line of Numbers, or from the firſt Term in Tangents, to the ſecond in Numbers, &c. But in moſt Caſes it is better to work by the Directions above, except when the Extent is too large for the Compaſſes.

3. By the *Sliding Rule*. Suppoſe the Line of Sines on the Rule to be marked with SS, and

and the Line of Sines on the Slider with S. Then the first Proportion will be thus wrought. Set 33°45′ on S to 56°15′ on SS; then against 121.39 on A, is 81.11 on B. (A signifies the double Line of Numbers upon the Rule, and B the double Number on the Slider). The second Proportion may be thus wrought: Set 33°45′ in the Tangents to Radius; then against 121.39 on A, is 81.11 on B. Or, if the Slider be so turned, as the Tangents and double Numbers may slide one by another, then the Radius may be set, *viz.* 45° of Tangents to 121.39 in the Line of Numbers; then against 33°45′ in Tangents, is 81.11 in the Line of Numbers. The third Proportion may be wrought as this last.

To do the same Geometrically. Draw the Base BA, and from a Diagonal Scale, or Scale of equal Parts, take with the Compasses 121.39, and set from B to A, and upon A raise a Perpendicular; then take 60 Degrees from the Line of Chords with the Compasses, and set one Foot in B, describe the Arch DE, and from the same Line of Chords 33°45′ and set from D to E; and draw the Line DC, till it cut the Perpendicular in C: Then if you measure AC by the same Scale you took BA from, you will find it 81.11; and if you measure BC, you will find it 146. *Fig.* 15. The next Case will be so resolved.

CASE II.

The two acute Angles B *and* C, *and the Base* B A *being given, find the Hypothenuse* B C. *Fig.* 12.

1. By making the Hypothenuse B C Radius.

As the Sine of the Angle C 56°15′	9.9198464
Is to the Base B A 121.394	2.0841992
So is the Radius 90° - -	10.0000000
To the Hypothenuse BC 146	2.1643528

2. By making the Base A B Radius. *Fig.* 13.

As Radius B A - - -	10.0000000
Is to the Base B A 121.394 - -	2.0841992
So is the Secant of the Angle B 33°45′	10.0801536
To the Hypothenuse BC 146	2.1643528

3. By making the Perpendicular AC Radius. *Fig.* 14.

As the Tangent of the Angle C 56°15′ Arith. Compl.	9.8248926
Is to the Base BA. 121.394	2.0841992
So is the Secant of the Angle C	10.2552610
To the Hypothenuse BC 146	2.1643528

By

By Scale and Compasses.

To work the first Proportion, extend the Compasses from the Sine of 56°15′ to 90°, which Extent will reach from 121.39 to 146 in the Line of Numbers.

By the Sliding Rule.

Set 56°15′ upon S to 90° upon SS, then against 121.39 upon B, is 146 upon A. But if you turn the Slider, so as the Sines and double Numbers may slide one by another, you may set 56°15′ of Sines to 121.39 in the Line of Numbers: Then against 90° of Sines you will have 146 in the Line of Numbers, and will find 33°45′ of Sines to be against 81.11 of Numbers. So that you may observe, if 90 of Sines be set to the longest Side or Hypothenuse, you will find every Angle against its opposite Side.

CASE III.

Two acute Angles B *and* C, *and the Hypothenuse* B C *being given, to find the Base* B A. *Fig.* 12.

1. By making the Hypothenuse B C Radius.

As Radius 90° - - -	10 0000000
Is to the Hypothenuse B C 146	2.1643528
So is the Sine of the Angle C 56°15′	9.9198464
To the Base B A 121.394.	2.0841992

2. By making the Base B A Radius. *Fig.* 13.

As the Secant of the Angle B 33°45′	10.0801536
Is to the Hypothenuse B C 146	2.1643528
So is the Radius 90° - -	10.0000000
To the Base B A 121.394	2.0841992

3. By making the Perpendicular A C Radius. *Fig.* 14.

As the Secant of the Angle C 56°15′ Arith. Compl.	9.7447390
Is to the Hypothenuse B C 146	2.1643528
So is the Tangent of the Angle C 56°15′	10.1751074
To the Base B A 121.394	2.0841992

By Scale and Compasses.

To work the first Proportion, extend the Compasses from 90° to 56°15 in the Sines, which Extent will reach from 146 to 121.394 in the Line of Numbers.

By the Sliding Rule.

Set 56°15′ upon S to 90° upon S S; then against 146 upon A, is 121.394 upon B.

By

By Geometrical Protraction.

Draw the Line B C, and from the Scale of equal Parts take 146, and set from B to C, with 60 Degrees of Chords describe the Arch DE, and set 56°15′ from E to D, and draw CA, and from B draw BA perpendicular to AC; then when AB is measured by the Scale, it will be found to contain 121.39. *Fig.* 15.

CASE IV.

The Base B A *and the Perpendicular* C A *being given, to find the two acute Angles* B *and* C. *Fig.* 13.

1. By making the Base B A Radius.

As the Base B A 121.394	2.0841992
Is to the Radius 45°	10.0000000
So is the Perpendicular A C 81.113	1.9090918
To the Tangent A C of the Angle B 33°45′	9.8248926

Whose Complement is 56°15′ the Angle C.

2. By making the Perpendicular A C Radius. *Fig.* 14.

As the Perpendicular A C 81.113	1.9090918
Is to the Radius 45°15′	10.0000000
So is the Base 121.394	2.0841992
To the Tangent of the Angle C 56°15′	10.1751074

Whose Complement is 33°45′ the Angle B.

By Scale and Compasses.

To work the first Proportion, extend the Compasses from 121.394 to 81.113 in the Line of Numbers, that Extent will reach from 45° to 33°45′ in the Tangents. For the second Proportion, extend from 18.113 to 121.394 in the Line of Numbers, that Extent will reach from 45° to 56°15′ in the Tangents.

By the Sliding Rule.

Let the Tangents and Numbers slide together, then set 121.394 in the Line of Numbers to 45° of Tangents, and against 81.113 in the Line of Numbers is 33°45′ and its Complement 56°15′ in the Line of Tangents.

This Case is done Geometrically, as the sixth.

CASE V.

The Base BA *and the Hypothenuse* B C *being given, to find the two acute Angles* B *and* C. *Fig.* 12.

1. By making the Hypothenuse B C Radius.

As the Hypothenuse B C 146	2.1643528
Is to the Radius 90°	10.0000000
So is the Base B A 121.394	2.0841991
To the Sine of the Angle C 56° 15′	9.9198463
Whose Complement 33° 45′ is the Angle B.	

2. By making the Base Radius

As the Base B A 121.394	2.0841992
Is to the Radius 90°	10.0000000
So is Hypothenuse 146	2.1643528
To the Secant of the Angle B 33° 45′	10.0801536

By Scale and Compasses.

For the first, extend the Compasses from 146 to 121.394, in the Line of Numbers, which will reach from 90° to 56° 15′ in the Sines.

By the Sliding Rule.

Set 146 upon A to 121.394 upon B, then against Radius on SS, is 56° 15′ on S.

By Geometrical Protraction.

Draw the Base B A, and from a Scale of equal Parts take 121.394 and set from B to A, and upon A raise the Perpendicular A C; then from the same Scale of equal Parts take 146, and set one Foot of the Compasses in B with the other cross A C in C, and draw BC. Then with 60° of Chords describe the Arch DE and measure D E with the Compasses on the Line of Chords, which will be 33°45′ the Measure of the Angle B, whose Complement is the Angle C. *Fig.* 15.

CASE VI.

The Base B A *and the Perpendicular* C A *being given, to find the Hypothenuse* B C. *Fig.* 16.

In this, and the next Case, we are first to find the acute Angle, and from thence the third Side.

1. The

1. The Perpendicular A C being made Radius.

As the Perpendicular C A 81. 113	1.9090918
Is to the Base B A 121.394	2.0841992
So is the Radius 45°	10.0000000
To the Tangent of the Angle C 56° 15′	2.1643528

2. The Hypothenuse B C being made Radius.

As the Sine of the Angle C 56° 15′	9.9198464
Is to the Base B A 121.394	2.0841999
So is the Radius 90°	10.0000000
To the Hypothenuse 146	2.1643528

By Scale and Compasses.

Extend the Compasses from 81.113 to 121.39 in the Line of Numbers, that Extent will reach from 45° to 56° 15′, in the Sign of Tangents; then extend from 56° 15′ to 90° in the Sines, that Extent will reach from 121.394 to 146.

By the Sliding Rule.

Set 81.113 in the Line of Numbers to 45° in the Tangents; then against 121.39 in the Numbers is 56° 15′ in the Tangents; then set 56° 15′ on S to 90° on SS; then against 121.39 on B is 146 on A.

By Geometrical Protraction.

Draw the Line B A, and from a Scale of equal Parts take 121.394 in the Compasses, and set from B to A, and upon A erect the Perpendicular A C; and from the same Scale take 81.113, and set from A to C; then draw the Hypothenuse B C, take B C in the Compasses, and on the Scale it will be found 146. Then with 60° of Chords describe the Arch D E. measure DE with the Compasses on the Line of Chords, which will be 33° 45′ the Measure of the Angle B, whose Complement is the Angle C. *Fig.* 15.

CASE VII.

The Base B A, *and the Hypothenuse being given, to find the Perpendicular* A C. *Fig.* 12.

1. The Hypothenuse B C being made Radius.

As the Hypothenuse B C 146	2.1643528
Is to the Radius 90°	10.0000000
So is the Base B A 121.394	2.0841992
To the Sine of the Angle C 56° 15′	9.9198464
Whose Complement is the Angle B 33° 45′	

2. The

2. The Hypothenuse B C being made Radius.

As Radius 90	10.0000000
Is to the Hypothenuse B C 146	2.1643528
So is the Sine of the Angle B 33° 45′	9.7447390
To the Perpendicular A C 81.113	1.9090918

By Scale and Compasses.

For the first Operation, extend the Compasses from 146. to 121.394 in the Line of Numbers, that Extent will reach from 90° to 33° 45′ in the Sines. Then for the second Operation, extend the Compasses from 90° to 33° 45′ in the Sines, that Extent will reach from 146 to 81.113 in the Line of Numbers.

By the Sliding Rule.

For the first, set 146 on A to 121.394 on B, then against 90 on SS there will be found 56° 15′ on S. Then for the second, set 90° on SS to 33° 45′ on S and against 146 on A, is 81.113 on B.

By Geometrical Protraction.

Draw the Line A B, and from the Scale take 121.394, which set from B to A, and upon A raise the Perpendicular A C, then from the Scale take 146, and set one Foot of the Compasses B, cross the Perpendicular in C, and measure A C on the Scale, which will be 81.113. *Fig.* 15.

The

The Seven Cases of Plain Triangles.
See *Plate*, *Fig.* 8.

Right Angled.			
Cafes.	Given.	Required.	Proportions.
I.	A B and B	A C	1. s C : B A : : s B : A C. 2. R : B A : : t B : A C. 3. t C : B A : : R : A C.
II.	A B and C	B C	1. s C : BA : : R : B C. 2. R : BA : : se B : B C. 3. t C : BA : : se C : B C.
III.	B C and B	B A	1. R : B C : : s C : B A. 2. se B : B C : : R : B A. 3. se C : B C : : t C : B A.
IV.	A B and A C	B and C	1. BA : R : : A C : t B. whofe Complement is C. 2. CA : R : : B A : t C. whofe Complement is B.
V.	B C and A C	B and C	1. BC : R : : BA : s C whofe Complement is B 2. BA : R : : BC : se B whofe Complement is C
VI.	A B and A C	B C	1. CA : BA : : R : t C. Then again, 2. s C : BA : : R : BC.
VII.	A B and B C	A C	1. BC : R : : BA : s C whofe Complement is B Then again, 2. R : B C : : B : s A C.

§. III.

§. III. *Of solving Oblique Angled* TRIANGLES.

CASE I.

The Angles C A B 62° 30′ *and* C B A 37° 30′ *and the Side* A C 350 *Feet being given, to find the other two Sides* C B *and* A B. *Fig.* 17.

As the Sine of the Angle C B A 37° 30′ Arith. Compl.	0.2155529
Is to the Side A C 350.	2.5440680
So is the Sine of the Angle C A B 62° 30′	9.9479289
To the Side B C 509.976.	2.7075498

For the Side A B.

As the Sine of the Angle C B A 37° 30′ Arith. Compl.	0.2155529
Is to the Side A C 350	2.5440680
So is the Sine of the Angle A C B 80°	9.9933515
To the Side A B 566.203.	2.7529724

The Parts required in the several Cases of oblique Trigonometry, may be found with the Scale and Compasses, by extending the Compasses from the first Term of the Proportion, to the second, and the same Extent will reach from the third Term to the fourth required. Also the Parts required may be found by the Sliding Rule, by setting the first Term against the second, then opposite to the third Term, the fourth Term may be found.

CASE II.

The two Sides A C 350 *and* C B 509.976, *and the Angle* C A B 62° 30′ *opposite to one of the given Sides,* C B *being given, to find the Angle* C B A *opposite to the other Side* A C. *Fig.* 17.

As the Side B C 509.976 Arith. Compl,	7.2924502
Is to the Sine of the Angle A 62° 30′	9.9479289
So is the Side A C 350	2.5440680
To the Sine of the Angle B 37° 30′	9.7844471

Or,

Or, if the two Sides A B and B C and the Angle opposite to he Side B C had been given, and the Angle C had been required; then,

s the Side B C 509.976 Arith. Compl.	7.2924502
to the Sine of the Angle A 62° 30′	9.9479289
o is the Side A B 566.203	2.7529724
To the Sine of the Angle C 80°	9.9933515

CASE III.

The Side A B 566.203, *the Side* A C 350, *and the Angle* A 62° 30′ *comprehended between the Sides* A B *and* A C *being given, to find the Angles* A C B *and* A B C. *Fig.* 17.

A B=566.203		180°	
A C=350	Subt.	62 30′	
The Sum 916.203	Rem.	117 30	=Sum of the Angles B and C.
Diff. 216.203		58 45	= half the Sum.

s 916.203 the Sum of the Sides Arith. Compl.	7.0380083
s to 216.203 the Difference of the Sides	2.3348617
o is the Tangent 58° 45′ half the Sum of the opposite Angles	10.2169438
To the Tangent 21° 15′ half the Difference of the opposite Angles, (by *Theor.* 3. *Sect.* 11.)	9.5898138

If 21° 15′ be added to 58° 45′ the Sum will be 80° the Angle ACB; and if 21° 15′ be subtracted from 58° 45′, the Remainder will be 37° 30′ the Angle A B C.

CASE IV.

The Side AB 566.203, *the Side* B C 509.976 *and the Angle* B 37° 30′ *comprehended between the Sides* A B *and* A C *being given, to find the third Side* A C. *Fig.* 17.

The Side A B	566.203	180° 00
The Side B C	509.976	37 30
The Sum	1076.179	142° 30
Difference	56.227	71° 15′

As

As 1076.179 the Sum of the Sides Arith. Compl. 6.9681154
Is to the Difference 56.227 1.7499449
So is the Tangent of half the Sum of the opposite Angles } 10.4692187

To the Tangent 8° 45′ half the Difference of the opposite Angles (by *Theor.* 3. *Sect.* II.) } 9.1871790

If 8° 45′ be added to 71° 15′, the Sum will be 80° the greater Angle C, and being subtracted the Remainder 62°30′ the lesser Angle A. Then,

As the Sine of the Angle A 62° 30′ Arith Compl. 0.0520711
Is to the Side B C 509.976 2.7075498
So is the Sine of the Angle B 37° 30′ 9.7844471

To the Side A C 350, which is required (by *Case* I. *Sect.* III. } 2.5440680

CASE V.

The three Sides A B 213.5, A C 103.5, *and* B C 250.2 *of an oblique Triangle* A B C *being given to find the three Angles. Fig.* 18.

As the greatest Side C B 250.2 Arith, Compl. 7.6017127
Is to the Sum of the other two Sides A B and A C 321. } 2.5065050
So is the Difference B E 106 of the two Sides A B and A C. } 2.0253059

To the Difference B F 135.995 of the Segments of the Base. } 2.133523[illegible]

Which Difference 135.995, subtracted from B C 250.2 the greatest Side, leaves F C 114. 205, the half whereof is G C 57.1025 the lesser Segment; which if subtracted from B C 250.2, the Remainder B G will be 193.0975, the greater Segment of the Base. Thus the oblique Triangle is reduced into two right-angled Triangles, *viz* A B G and A G C both right-angled at G, in each of which there is given the Hypothenuse and Base: So the Angles may be found by (Case V. *Of right angled plain Triangles*) thus:

As the Hypothenuse A B 213.5 2.329397
Is to the Radius 10.000000
So is the Base B G 193.0975 2.285776

To the Sine of the Angle B A G 640 44′ 51″ 9.956378
The Complement of B A G is A B G 25° 15′ 9″

Agai[n]

Again, in the Triangle A C G.

As the Hyyothenuſe A C 107.5	2.0314085
Is to the Radius	10.0000000
So is the Baſe G C 57.1025	1.7566552
To the Sine of the Angle G A C 32° 5′ 8″	9.7252467

The Complement of G A C is A C G 57° 54′ 52″.

This Caſe is demonſtrated from the fourth Theorem of Sect. II.

The Five Caſes of oblique-angled Triangles.
See *Plate, Fig.* 9.

Caſes.	Given.	Required.	Proportions.
I.	A C A and B	A B	s B : A C :: s C : A B.
II.	A C C B and B.	A	C A : s B :: C B : s A.
III.	A C C B and C.	A and B	C B + C A : C B — A C :: t $\frac{1}{2}$ A + B : t $\frac{1}{2}$ the Difference, which $\frac{1}{2}$ Dif. {added to / ſub. from} the $\frac{1}{2}$ Sum giv. the {greater / leſſer} Angle.
IV.	A C C B and C.	A B	Find the Angles A and B by the laſt Caſe; then, by the firſt Caſe, the Side A B will be found.
V.	A B A C and C B.	A, B and C.	B C : A B + A C :: A B — A C : B F. Then B C — B F = F C and $\frac{1}{2}$ F C is C G.

§. I. *Of*

§. I. *Of Trigonemetrical* PROBLEMS.

PROB. I.
To measure an accessible Altitude.

Let AB *represent a Tower*, *Steeple*, &c. *whose Height is required* ?

First, with the Quadrant, or other Instrument, find the Quantity of the Angle C, which suppose to be 52°30′, then measure the Distance A C; which suppose to be 85 Feet; then by *Case* I. of plain Triangles:

As the Sine of the Angle C B A 37° 30′ Arith. Compl.	0.215553
Is to the Base A C 85 Feet	1.929419
So is the Sine of the Angle C 52° 30′	9.899466
To the Altitude A B 110. 8	2.044438

Or thus,

As Radius	10.000000
Is to the Base A C 85	1.929419
So is the Tangent of the Angle C 52°30′	10.115019
To the Altitude 110.8	2.044438

Note, *That in this, and all such Cases, you must add the Height of your Eye, or Instrument to the Altitude before found.*

PROB. II.
To measure an inaccessible Altitude.

Let A B *be a Church Steeple, whose Height is required; but by reason of a River, or some other Obstacle, you cannot come to the Foot of it at* A.

First, Take, with the Quadrant at C, the Angle of Altitude, which, suppose to be 26° 30′; then measure in a right Line towards the Steeple to D, which suppose to be 75 Feet, and at D again observe the Angle of Altitude, which, let be 51°30′.

Now the two visual Lines C B and D B, and the measured Distance C D form the oblique angled Triangle C B D, wherein are given all the Angles, and the Side C D, the Angle B C D being 26° 30′ and the Complement of A D B 51° 30′ to 180 is the obtuse Angle B D C 128° 30′, and consequently, the third Angle C B D is 25°. But this Angle may be more readily found by subtracting B C D from A D B (by *Euclid.* l. 1. Prop. 32.) Then by Case I. *Of oblique, angled plain Triangles*, find the Side B D; Thus:

As the Sine of the Angle CBD 25° 30′	0.374052
Is to the Distance of CD 75	1.875067
So is the Sine of the Angle C 26° 30′	9.649527
To the visual Line B D 79.18	1.898640

Then by Case I. *Of right-angled plain Triangles.*

As Radius	10.000000
Is to BD 79.18	1.989640
So is the Sine of the Angle ADB 51° 32′	9.893544
To the Altitude AB 61.97.	1.729184

PROB. III.

To measure the Height of a Steeple, Tower, &c. standing upon a Hill.

First, Find the Angle CAB 44° and the Angle EAB 26°; then measure in a strait Line towards the Steeple from A to D 134 Feet: Then again at D, find the Angle CDB 67° 50′, and the Angle EDB 51°. By Case I. *Of oblique plain Triangles*, find the visual Line CD in the Triangle ACD, wherein are given the Angles DAC and ACD and the Side AD; Thus:

As the Sine of the Angle ACD 23° 51′	3.393536
Is to the measured Distance AD 134	2.127105
So is the Sine of the Angle CAD 44°	9.841771
To the Side CD 230.4	2.362412

Then, as Radius	10.000000
Is to the Side CD 230.4	2.362412
So is the Sine of the Angle CDB 67° 50′	9.966653
To the Side BC 213.3	2.329065

Again, As Radius	10.000000
Is to the Side CD 230.4	2.362412
So is the Sine of the Angle BCD 22° 10′	9.576689
To the Base BD 86.92	1.939101

Lastly, As Radius	10.000000
Is to the Base BD 86.92	1.939101
So is the Tangent of the Angle BDE 51′	10.091631
To the Perpendicular BE 107.3	2.030732

From the whole perpendicular Height BC	213.5
Subtract the Perpendicular Height of the Hill BE	107.3
There remains the Height CE of the Steeple	106

PROB. IV.

One Side BC 532 *of an oblique Triangle* ABC, *the Angle* A 110° 30′ *opposite to that Side, and the Sum of the other two Sides* AB *and* AC 637 *being given, to find the other two Sides and the Angles severally.* See Plate, Fig. 22.

Extend the Side BA to D, make AD equal to AC and draw DC, so there will be other two oblique-angled Triangles BDC and ADC. In the Triangle ABC is given, the Angle BAC 110° 30′, and in the Triangle ACD is given the Angle CAD 69° 30′ the Complement of the other to 180°; also the Triangle ADC is equicrural by Construction, therefore the Angles C and D at the Base are equal, and each of them is equal to ½ the given Angle BAC (by Prop. 32. *Euclid.* l. 1.) Now in the Triangle BCD there is given BC 532, BD 637, and the Angle BDC 55° 15′. Whence the Angle DCB may be found (by Case I. *Of oblique Triangles.*)

As the Side of BC 532 Arith. Comp.	7.2740884
Is to the Sine of the Angle BDC 55° 15′	9.9146852
So is the Side BD 637	2.8041394
To the Sine of the Angle BCD 100° 19′	9.9929130

From which subtract the Angle ACD 55° 15′, and the Remainder is 45° 4′ for the Angle ACB, and the Angle is 24° 26′, which is found by subtracting the Sum of BCD 100° 19′, and D 55° 15′ from 180°. The Sides AB and AC, are found (by Case I. *Of oblique Triangles*).

As the Sine of the Angle BAC 100° 30′ Arith. Compl.	0.0284124
Is to the Side BC 532	2.7259116
So is the Sine of the Angle ACB 45° 4′	9.8499897
To the Side AB 402.08	2.6043187

Again, As the Sine of the Angle BAC 110° 30′ Arith. Compl.	0.0284124
Is to the Side BC 532	2.7259116
So is the Sine of the Angle ABC 24° 26′	9.6166164
To the Side AC 234.93 ------	2.3709404

PROB.

PROB. V.

One Side B C 250.2 *of an oblique Triangle* A B C, *the Angle* B A C 96° 50′ *opposite thereto, and the Difference of* B D 106, *of the other two Sides* A B *and* A C *being given, to find the Angles* B *and* C, *and the two Sides severally.* See Plate, Fig. 23.

Make A D equal to A C, and draw C D; the Angle D A C being 96° 50′, the Complement thereof to 180° is 83° 10′ for the two Angles A D C and A C D; which being equal one to the other, therefore each of them is half of 83° 10′; and by drawing C D there is also another Triangle made, wherein is given B C 250.2 and B D 106, equal to the Difference of the two Sides A B and A C; and there is also given the Angle B D C 138° 25′, equal to the Complement of 41° 35′

As the Side B C 250.2 Arith. Compl.	7.6017127
Is to the Sine of the Angle B D C 138° 25′	9.8219775
So is the Side B D 106	2.0253059
To the the Sine of the Angle B C D 16° 19′ 52″	9.4489961

To which if A C D 41° 35 be aded the Sum of the Angle A C B will be 57° 54′ 52″: and if A be added to it, and the Sum subtracted from 180, there will remain the Angle A B C 25° 15′ 8″. Find the Sides A B and A C, as in the last Problem; Thus:

As the Sine of the Angle B A C 96° 50′ Arith. Compl.	0.0030960
Is to the Side B C 250.2	2.3982873
So is the Sine of the Angle A C B 57° 54′ 52″	9.9280146
To the Side A B 213.5	2.3293979

Again,

As the Sine of the Angle B A C 96° 50′ Arith. Compl.	0.0030960
Is to the Side B C 250.2	2.3982873
So is the Sine of the Angle A B C 25° 15′ 8″	9.6300247
To the Side A C 107.5	2.0314080

PROB. VI.

In the right angled Triangle A B C *there are given, Base* A B 40, *and the Sum of the Perpendicular* A C, *and Hypothenuse* A D 200, *to find the Perpendicular* A C *and Hypothenuse* C B *severally.* See Plate, Fig. 24.

In the Triangle A B D is given the Base and Perpendicular, to find the Angles A B D and A D; Thus:

As the Base A B 40	1.6020600
Is to the Radius 45	10.0000000
So is the Perpendicular A D 200	2.3010300
To the Tangent of the Angle A B D 78° 41′ 24″	10.6989700

Whose Complement is the Angle D 11° 18′ 36″, and because C D is equal to C B, therefore the Angle C B D is also 11° 18′ 36″; then if 11° 18′ 36″ be subtracted from the whole A B D 78° 41′ 24″ there will remain the Angle A B C 67° 22′ 48″. Then to find the Sides.

As Radius	10.0000000
Is to the Base	1.6020600
So is the Tangent of the Angle A B C 67° 22′ 48″	10.3802083
To the Perpendicular A C 96	1.9822683

Then subtract 96 from 200, and there will remain the Hypothenuse B C 104

PROB. VII.

Let B E *and* D *be three Objects, whose Distances are known, and* C *a Station from which all the Objects may be seen, and the Angles with each Object may be found. What is the Distance of each Object?* See Plate, Fig. 25.

B D 106, B E 53 25 D E 65, 5 *the Angles* B C E 13° 30′ *and* D C E 29° 50′ *are given, to find* B C, E C *and* D C.

The three Angles of the Triangle B D E *are found by* Case V. *Of oblique angled Triangles.*

Thro' the three Points B, D, and C describe a Circle, draw the Lines B C, D C and E C, which last continue to F, where it cuts the Circle, draw B F and D F. Then 180 — Angle B C D = Angle B F D = 136° 40′ (by Prop. 32. *Euclid.* l. 1.) and the Angle B D F = Angle B C F (by Prop. 21. *Euclid.* l. 3.) and so the Angle D B F = Angle D C F. In the Triangle B F D all the Angles are given, and the Side B D, to find B F = 26, 059 to D F = 76, 843 (by Case I. *Of oblique angled Triangles.*) Then the Angle F D B Angle B D E = F D E; then in the Triangle F D E, are given the Sides E D, F D, and the included Angle F D E, to find the Angle F E D = 84° 30′ 24″ and 180—Angle F E D = 95° 29′ 36″; then in the Triangle E D C all the Angles , and the Side D E are given, to find E C = 107, 42 and D C = 131, 05. Lastly, In the Triangle B D C all the Angles and the two Sides B D and D C are given, to find the third Side B C 151.3.

PROB. VIII.

Suppose B *and* D *two Stations, whose Distance is* 47.5 *Yards, from whence the two Objects* C *and* E, *may be seen, and their Angles found by Observation,* viz. C B E 49°, E B D 28′

C D B

C D D 32°, *and* C D E 56° *it is required to find* B C, B E, D C, D E *and* C E. See Plate Fig. 26.

In the Triangle C B D, the Side B D and all the Angles are given, to find B C = 28, 7795, and D C = 54. 2349, (which is done by Case I. *Of oblique angled Triangles*) and in the Triangle B E D are given the same Things, to find B E = 58, 6775 and D E = 36, 1475, (by the same Case.) Lastly, In the Triangle B C E are given, B C B E and the included Angle C B E to find C E = 45,3378, (by Case IV. *Of oblique angled Triangles.*

PROB. IX.

Let C *and* E *be two Objects, whose Distance is known, and let* B *and* D *represent two Stations, from whence they may be both seen, and the horizontal Angles* C B E *and* D B E, C D E *and* C D B *found by Observation; but the Distance of the two Stations cannot be measured, What is the Distance of the two Stations, and the Objects from each Station?* See Plate, Fig. 27.

Draw another Figure c e d b, whose Side d b, suppose to be any Number, as 10, and similar to C E D B; now, upon Supposition, that b d is 10, and the small Figure similar to the great one, we can, by the last Problem, find d e = 7,61, b e = 12,353116, b c = 6,05885, d c = 11,41787, and c e = 9,5448. Now, if by working in this Manner, c e had been found = C E = 45,3378, then it is plain, all the Side had been exactly found; but as it has not been found by similar Triangles, the true Sides may be found by those already discovered, thus, as, c e : C E :: c b : C B = 28, 7795; and as, c e : C E :: c d : C D; and c b : C B :: b d : B D = 47,5; and as, c e : C E :: e d : E D = 36,1475; and so of the rest.

LOGARITHMS.

Purposing to give you the Solution of some of the Questions in this Book by those excellent Numbers the Logarithms; take these Directions for the better nnderstanding the Nature and Use of them.

They are artificial Numbers, fitted to the natural, for the Ease of Calculation; and are printed in Tables having two Columns. One hath the natural Number; against it in the other is his Logarithms: So that the Logarithm of a whole Number is easily found.

The Tables begin at 1, whose Logarithm is 0,00000; and reach commonly to 10,000; consisting every one of 8 Figures, though (unless in great Numbers) we seldom use above six; (if the Figures left out exceed 50, we put an Unite to the sixth) to the Logarithms are annexed Differences; by the Help of which, and a Table of proportional Parts adjoined, you are directed to find the Logarithm of any Number to 100,000. But these are but of 7 Places.

Mr. *Wingate*, in his *Tabulæ Logarithmicæ*, hath the Logarithms to 100,000 with Differences alſo; whereby making a Proportion, (which is done ſpeedily by one Slip of this Rule) you have the Logarithms as far as 1,000,000 in a portable Volume for the Pocket. A Book which I commend to any that delight in Arithmetick.

The firſt Figure, called the Index, (which is commonly ſeparated by a Point, better left out, except in the firſt hundred, as in the late printed Tables) ſhews how many Figures the anſwering Number, if whole, or the whole Part thereof, if it hath a Decimal annexed, conſiſteth of; which are always more by one than the Index. So 0, is the Index of one Figure, 1 of two Figures, 2 of three, 3 of four, *&c.*

Alſo according to the excellent Way of Mr. *Chriſtopher Townly*, cited by Sir *Jonas Moor* in his Mathematical Compendium, the Log. of a Decimal is the ſame, as if it were a whole Number, with this Direction for the Index.

If the Decimal be of the firſt Rate, the Index is 9; if of the ſecond Rate, the Index is 8; if of the third Rate, the Index is 7, *&c.* that is, the Index of the Logarithm of any Decimal, wants as many Units of ten, as the left Hand ſignificant Figure is diſtant from Unity: Which, I hope, you will underſtand, if you obſerve this following Table.

Perf. Numb.	*Log.*
3536.	3.54851
353.6	2.54851
35.36	1.54851
3.536	0.54851
Decimals.	*Log.*
.3536	9.54851
.03536	8.54851
.003536	7.54851
.0003536	6.54851

Where you ſee, That in the perfect Numbers, the Index ſheweth the Number of Places in the whole Numbers, and in the whole Part of the mixt, being always leſs by one than the ſaid Places; but in Decimals it ſheweth the Rate, being the Complement thereof to Ten, not regarding the Number of Places.

If then you would have the Log. of any Number, find the Log. thereof in the Table, as if it were whole; and prefix the Index anſwering the Value.

And having a Log. find the Number anſwering in the Table, and by a Point fix the Value according to the Index.

To find a Log. to a Number of ſix Places in the Tabulæ Logarithmicæ *by Help of this Rule.*

Call the Difference at the Bottom the Tabular Differences. Having the Log. of the five firſt Figures, by the double Scale on your Rule, ſet 10 to the Tabular Differences; againſt

gainst your sixth Figure is his proportional Part to be added to the Log. before found.

To find a Number of six Places answering a Log. given.

Find the Number of five Places answering the Log. in the Table, next less to the given Log. subtract the said Log. out of the given Log. call the Remainder the proper Difference; then by the double Scale on your Rule set 10 to the Tabular Difference; against the proper Difference on the second, is your sixth Figure on the first, to be annexed to the five Figures before found.

Note, That you must use all the eight Figures in these Cases.

Some Uses of the Logarithms.

Whereas, before the aforesaid Contrivance of the Indices by Mr. *Townley*, if one Number were perfect, and the other a Decimal, there was a different Rule in every Operation for them; but by the said Contrivance one is now sufficient: I will give Examples only, in which one Number is a Decimal, with these two Directions.

1. In the Log. which answereth the Question, (whether it be a Sum, Remainder, Half, *&c.*) if the Index be ten, or above, neglect or cancel the said Figure in the Place of Tens.

2. Where you are ordered to subtract a greater Log. out of a less; add ten to the Index of the less, and then subtract.

1. *Multiplication.*

Add the Logs. of the two, or more Numbers to be multiplied; the Sum is the Log. of the Product. So 12 multiplied by the Decimal .25, the Product is 3.

	12.	1.07918
By	.25	9.39794
	3.	1 047712

It may also be done where there are but two, by subtracting the Arithmetick Complement of the Log. of one of them out of the Log. of the other; the Remainder is the Log. of the Product.

Which Arithmetical Complement is the Remainder of every Figure, (including the Index) to 9; except of the last significant Figure to the right Hand, whose Remainder you must take to Ten. As in these three Examples.

Numb.		
2.	0.30103	*Log.*
.5	9.69897	*Ar. Compl.*
Numb.		
80.	1.90309	*Log.*
.0125	8.09691	*Ar. Compl.*
Numb.		
100	2.00000	*Log.*
.01	8.00000	*Ar. Compl.*

2. *Division.*

Subtract the Log. of the Divisor out of the Log. of the Dividend, (whether of the two be

be greater or less) the Remainder is the Log. of the Quotient. So 12 divided by the Decimal .25; the Quotient is 48.

12.	1.07918
By .25	9.39794
48.	1.68124

It may also very conveniently be done, by adding the Ar. Compl. of the Log. of the Divisor to the Log. of the Dividend; the Sum is the Log. of the Quotient, as followeth.

3. *The Rule of Three Direct.*

1. Add the Logarithms of the second and third; from the Sum subtract the Log. of the first; the Remainder is the Log. of the fourth.

2. A better Way: Add the Ar. Compl. of the Log. of the first to the Logarithms of the second and third; the Sum is the Log. of the fourth. *Example.* If .25 give 16. What shall 12. give?

Ar. Compl. .25	0.60206
16.	1.20412
12.	1.07918
768.	2.88536

Ans. 768.

But in the inverse Rule: Add the Ar. Compl. of the Log. of the third to the Logarithms of the first and second; the Sum is the Log. of the fourth. Thus are resolv'd the Questions wrought on the double Scale.

But for those in this Book, where there is a duplicate Proportion, as in Timber Measure and Gauging, if the first and third Numbers be on the square Line, there are general or fix'd Logarithms belonging to the first Numbers; to which if you add the Log. of the second, and the Log. of the third twice, the Sum of all four is the Log. of the fourth.

If the second and fourth Numbers be on the square Line; to the Ar. Compl. of the Log. of the first, add the Log. of the third, and the Log. of the second twice, half the Sum is the Log. of the fourth.

4. *The Square Root.*

Half the Log. of the Number given, is the full Log. of the Square Root.

If the Number be a Decimal, add ten to the Index, and then halve it, as here.

.25	19.39794
.5	9.69897

5. *The Cube Root.*

The third Part of the Log. of the Number given, is the full Log. of the Cube Root.

If the Number be a Decimal, add twenty to the Index, and then divide by three, as here.

.25	29.39794
.63	9.79931

6. To find a mean Proportional between two Numbers.

Add their Logs. together: Half the Sum is the Log. of the mean Proportional.

When one is a Decimal, if the Sum of the Indices be ten, (as here) or above; caſt away ten, and then halve it; if it be not ten, add ten to it, and then halve it.

12.	1.07918
·25	9·39794
	10.47712
1.732	0.23856

7. To find two, or more mean Proportionals between two Numbers.

This, in Caſe of a Decimal, was ſomething perplex'd, as you may ſee in Mr. *Wingate's* Artificial Arithmetick: It is now, by the aforeſaid Contrivance of Mr. *Townley*, as eaſy, as it is uſeful.

Subtract the Log. of the leſs Number out of the Log. of the greater: The Remainder divide by a Number greater by one, than the Number of Means ſought; as here, by 4 for three Means.

12.	1.07918
·25	9·39794
	1.68124
	42031

This Quotient added to the Log. of the leſs Number; the Sum is the Log. of the firſt Mean; to which adding again the ſaid Quotient, the Sum is the Log. of the ſecond Mean. And ſo forward for as many Means, as the Quotient was at firſt ordered for.

Means.

		9·39794
		42031
1	.658	9.81825
		42031
2	1·732	0.23856
		42031
3	4·556	0.65887

8. To find the Log. of a Vulgar Fraction.

Subtract the Log. of the Denominator out of the Log. of the Numerator, the Remainder is the Log. of a Decimal equivalent to the ſaid vulgar Fraction.

$\frac{3}{4}$	0.47712
	0.60206
·75	9·87506

9. To find the Log. of a Number with a Vulgar Fraction annex'd.

Suppoſe it to be 12 $\frac{1}{4}$; change the Number into an improper Fraction, by multiplying the whole Number by the Denominator of the Fraction, and adding the Numerator to the Product,

duct, the Sum is the Numerator of the improper Fraction.

$\frac{49}{4}$	1.69020
	0.60206
12.25	108814

Then ſubtract the Log. of the Denominator out of the Log. of the Numerator, as before; the Remainder is the Log. of the ſaid Number, with a Decimal, equal to the ſaid vulgar Fraction, annexed.

I have, as an Appendix to this Part, adjoined the uſual Decimal Tables, and compriſed them into five: Yet the Uſe of them is as eaſy, as if they were all ſingle.

The Integers, or Wholes, are ſet on the Top; and the Parts follow in order, with their Decimals annexed.

TABLE

TABLE I.

A Table of English *Coin, a Pound Sterling, also Troy Weight, an Ounce* } *Integer.*

Shillings and Penny Weight.	Decimals.	Pence with Farthings.	Decimals.	Grains.
19	.95	3	.0489583	
18	.9	2	.0479166	23
17	.85	1	.046875	
16	.8	11	.0458333	22
15	.75	3	.0447916	
14	.7	2	.04375	21
13	.65	1	.0427083	
12	.6	10	.0416666	20
11	.55	3	.040625	
10	.5	2	.0395833	19
9	.45	1	.0385416	
8	.4	9	.0375	18
7	.35	3	.0364583	
6	.3	2	.0354166	17
5	.25	1	.034375	
4	.2	8	.0333333	16
3	.15	3	.0322916	
2	.1	2	.03125	15
1	.05	1	.0302083	
		7	.0291666	14
		3	.028125	
		2	.0270833	13
		1	.0260416	
		6	.025	12
		3	.0239583	
		2	.0229160	11
		1	.021875	

The Residue of the Table.

Pence with Farthings.	Decimals.	Grains.
5	.0201333	10
3	.0197916	
2	.01875	9
1	.0177083	
4	.0166666	8
3	.015625	
2	.0145833	7
1	.0135416	
3	.0125	6
3	.0114583	
2	,0104166	5
1	,009375	
2	.0083333	4
3	.0072916	
2	.00625	3
1	.0052083	
1	.0041666	2
3	.003125	
2	.0020833	1
1	.0010416	½
½	.0005208	½

TABLE II.

Averdupois *great Weight, One hundred at* 112 l. *Integer.*

Quarters.	Decimals.
3	·75
2	·5
1	.25

Pounds.	Decimals.
27	.2410714
26	.2321428
25	.2232143
24	.2142857
23	.2053571
22	.1964286
21	.1875
20	.1785714
19	.1696428
18	.1607143
17	.1517857
16	.1428571
15	.1339286
14	.125
13	.1160714
12	.1071428
11	.0982143
10	.0892857
9	.0803571
8	.0714286
7	.0625
6	.0535741
5	.0446428
4	.0357143
3	.0267857
2	.0178571
1	.0089286

The Residue of the Table.

Ounces.	Decimals.
15	.0083705
14	.0078126
13	.0072545
12	.0066964
11	.0061384
10	.0055803
9	.0050223
8	.0044643
7	.0039062
6	.0033482
5	.0027902
4	.0022321
3	.0016741
2	.0011161
1	.000558

Quarters.	Decimals.
3	.0004185
2	.000279
1	.0001395

TABLE III.

Averdupois *little Weight, one Pound long Measure, one Yard or Ell,* } *Integer.*

Ounces.	Decimals.	Qtrs. with Nails.
15	.9375	3
14	.875	2
13	.8125	1
12	.75	3
11	.6875	3
10	.625	2
9	.5625	1
8	.5	2
7	.4375	3
6	.375	2
5	.3125	1
4	.25	1
3	.1875	3
2	.125	2
1	.0625	1

The Residue of the Table.

Drams.	Decimals.	Qtrs. of Nails.
15	.0585937	
14	.0546875	
13	.0507812	
12	.046875	3
11	.0429687	
10	.0390625	
9	.0351562	
8	.03125	2
7	.0273437	
6	.0234375	
5	.0195312	
4	.015625	1
3	.0117187	
2	.0078125	
1	.0039062	

Qtrs.	Decimals.
3	.0029297
2	.0019531
1	.0009765

TABLE IV.

Liquid Measure, one Gallon. Dry Measure, one Quarter. } *Integer.*

Pints.	Decimals.	Bushels.
7	.875	7
6	.75	6
5	.625	5
4	.5	4
3	.375	3
2	.25	2
1	.125	1
Quarters.	Decimals.	Pecks.
3	.09375	3
2	.0625	2
1	.03125	1
	Decimals	Quarters of a Peck.
	.0234375	3
	.015625	2
	.0078125	1
	Decimals	Pin
	.0058594	3
	.0039063	2
	.0019531	1

TABLE V.

Dozens, or Gross Time, one Year. Long Meas. 1 Foot. Pence 1 Shilling. } *Integer.*

Dozens. Months	Decimals.	Inches Pence.
11	.9166667	11
10	.8333333	10
9	.75	9
8	.6666667	8
7	.5833333	7
6	.5	6
5	.4166667	5
4	.3333333	4
3	.25	3
2	.1666667	2
1	.0833333	1
Parts.	Decimals.	Quarters & Farth.
11	.0763889	
10	.0694444	
9	.0625	3
8	.0555555	
7	.0486111	
6	.0416667	2
5	.0347222	
4	.0277778	
3	.0208333	1
2	.0138889	
1	.0069444	

Days

Days belonging to the Table of Time.			
Days.	Decimals.	Days	Decimals.
30	.08219178	15	.0410959
29	.079452	14	.0383562
28	.0767123	13	.0356164
27	.0739726	12	.0328767
26	.0712329	11	.030137
25	.0684931	10	.0273972
24	.0657534	9	.0246575
23	.0630137	8	.0219178
22	.060274	7	.0191781
21	.0575342	6	.0164383
20	.0547945	5	.0136986
19	.0520548	4	.0109589
18	.0493151	3	.0082192
17	.0465753	2	.0054794
16	.0438356	1	.0027397

To bring Decimals into known Parts.

Multiply the Number of Parts in one Integer, and the Decimals together: From the Product cut off so many Figures to the right Hand as are in the Decimals (as you are directed in Multiplication of Decimals.) The Residue to the left Hand are the Parts sought; and the Figures cut off are a Decimal of one of those Parts, to be reduced the same way into the next less Parts, if there be any, or if there be need. If nothing be left to the left Hand, there is not one of those Parts in that Decimal: Therefore account it cut off, and proceed to find the next less Parts, as before.

The making the foregoing Tables is by dividing the Numerator of the vulgar Fraction, which represents the Parts, by the Denominator; the Quotient is the Decimal. So $\frac{11}{20}$ being the vulgar Fraction of 11 Shillings, or 11 Penny-weights; if you divide 11 by 20, the Quotient .55 is the Decimal: So that half the Number of Shillings or Penny-weights is the Decimal. Also $\frac{26}{960}$ being the vulgar Fraction of 6 *d.* $\frac{1}{2}$ or of 26 Farthings; if you divide 26 by

by 960, the Quotient .0270830, &c. is the Decimal.

Yet you ſhall not need Diviſion for every Decimal; for ſome are found by halving the Integer or 1: and ſo continually: So are found the Decimal of one half, one quarter, one half quarter, &c. Some are found by halving a Decimal before found: So half the Decimal of a Shilling, is the Decimal of Six-pence; half of that the Decimal of Three-pence, &c. Alſo one third Part of the Decimal of a Shilling, is the Decimal of Four-pence; and the half of that, the Decimal of Two-pence, &c. and the double of it the Decimal of Eight-pence. Likewiſe the Sum of two Decimals, is the Decimal of the Sum of the two Fractions whoſe Decimals they are; and the Difference is the Decimal of their Difference.

Some of theſe are of one Place, and ſome of more: Few Tables have them to above ſeven; and moſt ordinary Queſtions may be reſolved to a ſufficient Exactneſs, if you uſe but four; remembering the Direction above given, *viz.* If the firſt Figure of thoſe left out exceed 5, to add a Unite to the laſt of thoſe you retain.

If the Anſwer of a Queſtion be in Money, three Places of Decimals give it to near a Farthing, as is ſhewn after *Part* 4. *Prop.* 5.

Now for the Uſe of them in a Queſtion or two.

1. At 5 *s.* 3 *d.* $\frac{1}{2}$ the Ounce; what coſt 7 Ounces, 3 Penny-weight, and 19 Grains?

Having added the Decimals of the Parts, the Queſtion will ſtand thus:

$$\begin{array}{ccccccc} ou. & & l. & & ou. & & l. \\ 1 & : & 0.2645833 & :: & 7.1895833 & : & 1.9022 \end{array}$$

The Product or Anſwer is 1 *l.* 9022, &c. Which is 1. *l* 18 *s.* 0 *d.* 2 *f.* near.

If you leave out the three laſt Figures in each Decimal, with the Condition abovementioned, the Numbers are

$$\begin{array}{ccccc} ou. & & l. & & ou. \\ 1 & : & 0.2646 & :: & 7.1896 \end{array}$$

And the Anſwer is 1 *l.* 9023. &c. differing from the other inconſiderably.

2. To compute ſimple Intereſt for any Sum, Rate and Time. Having put the Parts, if there be any, into their Decimals; multiply the Principal and the Rate; from the Product cut off the due Decimal, if any, and two Places more for the Diviſion by 100: This Product ſo ordered is the Intereſt due for one Year; which if you multiply by the Time,

(be

(be it more or less than a Year) the Product (the due Decimal cut off) is the Interest for that Time.

Example 1. What is the simple Interest of 132 *l.* 7 *s.* 6 *d.* for 2 *y.* 3 *m:* 22 *d.* at 6 *l.* in the Hundred?

The Decimal of 7 *s.* 6 *d.* is .375; which being annexed to the whole Pounds, the Principal will be 132 *l.* 375, which multiplied by 6, and the Product ordered as directed, it will be 7.9425, or 7 *l.* 18 *s.* 10 *d.* 1 *f.* near, for the Interest for one Year. But that being not the Sum sought, multiply the said 7.9425 and the Time, *viz.* 2 *y.* 3103, the Product 18.3493 is the Interest sought, *viz.* 18 *l.* 6 *s.* 11 *d.* 3 *f.*

Example 2. What is the Interest of the said Sum for two Months and ten Days at the same Rate? Multiply the said 7.9425 by .1941 the Decimal of the Time, the Product 1 *l.* 5416, or 1 *l.* 10 *s.* 10 *d.* is the Interest sought.

But the great Convenience of Decimals, is, that their Logs. are so easily found; as is already shewn in this second Section. So that by the *Tabulæ Logarithmicæ* mentioned in the aforecited Place, any Question, whose Numbers (whether whole, mixt, or Decimals) exceed not six Places, may be speedily resolved: Mr. *Townley*'s Indices of the Decimals freeing us from Perplexity of different Rules. As in the two last Examples.

Example 1.

100. *Ar. Com.* 8.	
132.375.	2.1218052
6.	0.7781512
7.9425	0.8999571
2.3103	0.3636083
18.3495	1.2636254

Example 2.

100. *Ar. Com.* 8.	
132.375	2.1218059
6.	0.7781512
.1941	9.2880255
1.5410	0.1879826

To the Arith. Compl. of the Log. of 100, *viz.* 8.0000000 add the Log. of the Principal and of the Rate; the Sum is the Log. of the Interest for one Year. To which Log. if you add the Log. of the Time, this Sum shall be the Log. of the Interest for the Time.

Or without seeking the Interest for one Year: To the said Ar. Compl. add the Logs. of the Principal, Rate, and Time, the Sum shall be the Log. of the Interest demanded, as in the second Example.

3. Compound Interest for any Principal, Rate, and Time by the Logarithms.

In this Proposition the Excellency of those Numbers appear; such Questions being resolved by them with great Ease and Speed; but by natural Arithmetick not without considerable Time and Trouble.

Deduct the Log. of 100 from the Log. of 100, and the Rate added

added together, as 105, 106, &c. The Difference multiply by the Time: From the Product cut off the Decimal, if there be any: The Remainder add to the Logarithm of the Principal; the Sum is the Logarithm of the Principal and Interest required.

Example.

Let the Principal, Rate, and Time be as in the former of the two last Questions. Pursuing the Rule, as you see in the Margin; the Sum of the principal and compound Interest is 151 *l.* 9 *s.*

The Difference		253058
The Time		2.3103
The Product		584639.8974
	132.375	2.1218059
		584639
	151.45	2.1102698

It seems by this, that the Interest of 100 *l.* at 6 *l. per Cent.* by the Year, is not fully amounted to 3 *l.* in six Months; for if you multiply the aforesaid Difference by 5, the Decimal of six Months; and, having cut off one Place, add the Residue to the Log. of 100, the Sum will be 2.0126529; which is the Log. of 102.956, that is 102 *l.* 19 *s.* 1 *d.* 1 *f.*

I will add two or three Examples more, which, I hope, will be sufficient.

1. What is the Value of 28 Ounces, six Penny Weights and 15 Grains of Gold, at 3 *l.* 3 *s.* 6 *d.* the Ounce? Annexing the Decimals to the Integers, the Numbers stand thus:

ou.	*l.*	*ou.*	*l.*
1 :	3.175 : :	28.33125 :	89.952

	l.	*s.*	*d.*	*f.*	3.175	9.5017437
Facit,	89 .	19 :	00 .	2	28.33125	1.4522657
					89.952	1.9540094

2. If 4 . 9 . 12 (*ou. p. gr.*) of Gold cost 14 . 10 . 9 (*l. s. d.*); What is that the Ounce?

	ou.	*l.*	*ou.*	*l.*
The Numbers are	4.475 :	14.51875 : :	1 :	3.2444

	l.	*s.*	*d.*	*f.*	4.475 *Ar. Compl.*	9.3492070
Facit,	3 .	04 .	10 .	2.	14.51875	1.1619291
					3.2444	.5111361

3. At 6 *s.* 3 *d.* the Ounce; how much Silver Plate will 5 *l.* 3 *s.* 6 *d.* buy?

	l.	*ou.*	*l.*	*ou.*
The Numbers are	0.3125 :	1 : :	5.175 :	16.56

ou.	*p.*	*gr.*	.3125 *Ar. Compl.*	0.50515
Facit, 16.	11.	05 near.	5.175	0.71391
			16.56	1.21909

I have taken but six Figures in this last Example. If I had used no more in the other, the Difference would have been little or inconsiderable; as you may find if you please to give your self that small Trouble.

TRILATERAL [in *Geometry*] three sided.

TRILLION [in *Arithmetick*] the Number of a Billion of Billions.

To TRIM [in *Carpentry*, &c.] a Term us'd for fitting one Piece into another, who then say, trim in a Piece.

TRIMMERS [in *Architecture*] Pieces of Timber that are fram'd at Right Angles to the Joints, against the ways for Chimneys and Well Holes for Stairs.

TRINE *Dimension*, or three-fol'd *Dimensions*, includes Length Breadth and Thickness. The *Trine Dimension* is peculiar to Bodies or Solids.

TRINGLE [in *Architecture*] a Name common to several little square Members or Ornaments, as *Reglets*, *Listels*, or *Plat-bands*.

TRINGLE is particularly us'd for a little Member fix'd exactly over every Triglyph, under the Plat-Band of the Architrave, from whence the *Guttæ* or Pendant Drops, hang down.

TRIPARTITION is a Division by three; or the taking the third Part of any Number or Quantity.

TRIPLE, *Three-fold.*

TRISECTION } [in *Geometry*]
TRISSECTION }
the dividing a Thing by three; it is chiefly us'd for the Division of an Angle.

The Trisection of an Angle Geometrically, is one of those great Problems, the Solution of which has been so much sought after by Mathematicians for 2000 Years; being in this respect on a Footing with the Quadrature of the Circle, and the duplicate of the Cube Angle.

Several late Authors have written on the *Trisection of a Triangle*; and pretend to have found out the Demonstration, but they have all committed Paralogisms.

TROCHILE } [in *Archi-*
TROCHILUS } *tecture*] is that hollow Ring or Cavity, which runs round a Column, next to the *Tore*; or it is one whose Cavity is compos'd of two Arches.

TROCHLEA is one of the Mechanical Powers, and is what we usually call the Pulley.

TROCHOID [in *Geometry*] a Curve, whose Genesis may be thus conceiv'd. If a Wheel or Circle be mov'd with a two-fold Motion at the same time, the one in a Right-Line, and the other circularly about its Centre, and these two Motions be equal; *i. e.* describe two equal Lines in the same time: and if in the Radius; which at the beginning of the Motion reaches from the Centre of the Wheel, or the first Point of the Line, which describes the Circumference If, I say, in this Radius a Point be taken any where, except in the Centre, this Point will describe a Curve, one Part of which will be below the Line describ'd by the Centre, and the other above it; this Line thus describ'd by the Point taken in the Radius, is call'd the *Trochoid*.

The Right-Line which joins the two Extremities of the *Trochoid*, and which is either the Path the Wheel makes, or a Line parallel to that Path is call'd the Base of the *Trochoid*.

The Axis of the *Trochoid* is the Diameter of the Wheel, perpendicular to the Base in the middle of the Motion; or that Part of the Radius between the *Trochoid* and its Base.

The Point wherein the Axis is cut into two Parts by the Line describ'd by the Centre of the Wheel, is call'd the Centre of the *Trochoid*; the uppermost Point of the Axis, the Vertex of the *Trochoid*; and the Plane comprehended between the *Trochoid* and its Base, the *Trochoidal Space*.

The *Trochoid* is the same with what is otherwise call'd the *Cycloid*; the Properties, *&c.* of which you may see under the Article *Cycloid*.

TROPHY [in *Architecture*] is an Ornament which represents the Trunk of a Tree, charg'd or encompass'd all around about with Arms or military Weapons, both offensive and defensive.

TRUNCATED *Pyramid*, or *Cone*, is one whose Top or Vertex is cut off by a Plane parallel to its Base.

TRUNK [in *Architecture*] is us'd for the Fust or Shaft of a Column, with that Part of the Pedestal between the Base and the Cornice, call'd the Die.

TUBE, a *Pipe*, *Conduit* or *Canal*; being a Cylinder hollow within, either of Iron, Lead, Wood, *&c.* for the Air or some other Fluid to have a free Passage.

TUSCAN *Order* [in *Architecture*] is the first, simplest and most massive of the five Orders.

The *Tuscan* is call'd the *Rustic* Order by *Vitruvius*, and M. *de Chambray* agrees with him, who in his Parallel says, it never ought to be us'd but in Country Houses and Palaces.

M. *Le*

M. *Le Clerc* adds, that in the Manner *Vitruvius* and *Palladio*, and some others have ordered it, it does not deserve to be us'd at all. But in *Vignola*'s Manner of Composition, he allows it a Beauty, even in its Simplicity; and such as makes it proper, not only for private Houses, but even for publick Buildings; as in the Piazza's of Squares and Markets; in the Magazines and Granaries of Cities, and even in the Offices and lower Apartments of Palaces.

The *Tuscan* has its Character and Proportions, as well as the other Orders; but we have no ancient Monument, to give us any regular *Tuscan* Order for a Standard.

M *Perrault* observes, that the Characters of the *Tuscan* are nearly the same with those of the *Doric*; and adds, that the *Tuscan* is in Effect no other than the *Doric*, made somewhat stronger, by shortening the Shaft of the Column; and more simple, by the small Number and largeness of the Mouldings.

Vitruvius makes the whole Height of the Order 14 Modules, in which he is follow'd by *Vitruvius*, M. *Le Clerc*, &c. *Serlio* makes it but 12; *Palladio* gives us one *Tuscan* Profile much the same as that of *Vitruvius*, and another too rich, on which Side *Scammozzi* is likewise too faulty.

Hence it is that that of *Vignola*, who has made the Order very regular, is most follow'd by modern Architects.

The *Tuscan* is the most easily executed of all the Orders; in that it has neither Triglyphs, nor Dentils, nor Modillions to confine its Inter-columns.

On this Account, the Columns of this Order may be rang'd in any of the five Manners of *Vitruvius*, *viz.* the *Pycnostyle*, *Sistyle*, *Eustyle*, *Diastyle* and *Aræostyle.*

TUSCAN *Order, by Proportions of equal Parts.*

The Height of the *Pedestal* being two Diameters, is divided into 4, giving 1 to the Base, whose Plinth[a] is $\frac{2}{3}$ thereof, the other Part is divided into 3, giving 1 to the Fillet[b], and 2 to the Hollow[c]. The Breadth of the Die, or Naked, is one Diameter and $\frac{1}{3}$: and the *Projection* of the Base is equal to its Height the Fillet hath $\frac{3}{4}$ thereof.

The Height of the *Cornice* is half the Base, being $\frac{1}{8}$ of the whole Height, and is divided into 8, giving 2 to the Hollow[d], 1 to the Fillet[e], and 5 to the Band[f]; the *Projection* is equal to the Base, and the Fillet hath three of these Parts.

Base of the Column: The Height is $\frac{1}{2}$ a Diameter, and is divided into six Parts, giving 3 to the Plinth[g], 2 and $\frac{1}{2}$ to the Torus[h], and $\frac{1}{2}$ a Part to the Fillet; the whole *Projection* is $\frac{1}{3}$ of its Height, and the Fillet equal to its Height. The Hollow or Cincture[i] is $\frac{1}{4}$ of a Circle in all the Orders, and belongs to the Shaft of the Column.

The *Diminiſhing* of this Column is $\frac{1}{4}$ of the Diameter.

The Height of the *Capital* is $\frac{1}{2}$ a Diameter, and is divided into 9, giving $2\frac{1}{2}$ to the Frieze[k] of the Capital, $\frac{1}{2}$ a Part to the Fillet, 3 to the Ovolo[l], and 3 to the Abacus[m]. The whole *Projection* is $\frac{5}{8}$ of the Diameter being perpendicular to the Body of the Column below, and the Fillet projects equal to its Height.

The *Collerino*[n] or Necking of all the Orders in general is one of thoſe nine Parts in the Capital, and the Fillet half a Part; the *Projection* is 1 and $\frac{1}{4}$ of theſe Parts, and the Fillet equal to its Height.

The Height of the *Entablature* being one Diameter and $\frac{3}{4}$, is divided into 6, giving 2 to the Architrave, 1 and $\frac{1}{2}$ to the Frize, and $2\frac{1}{2}$ to the Cornice.

For the Members of the *Architrave*, divide the Height into ſeven Parts, giving 2 and $\frac{1}{2}$ to the firſt Face[o], 3 and $\frac{1}{2}$ to the ſecond[p], and 1 to the Band at Top[q]; the *Projection* is equal to the Band, and the ſecond Face a third thereof.

N. B. The firſt Face of all the *Architraves* is perpendicular to the Naked of the Column at the Top.

For the *Cornice*, divide the Height into 9, giving 1 $\frac{1}{2}$ to the Hollow[r], $\frac{1}{2}$ a Part to the Fillet, 1 and $\frac{1}{2}$ to the Ovolo[ſ], 2 to the Corona[t], $\frac{1}{2}$ a Part to the Fillet, 2 to the Scima Recta[u], and 1 to the Fillet. For the *Projections*, the Hollow hath 2 of theſe Parts, the Ovolo 3 and $\frac{1}{2}$, the Corona 6, the Fillet 6 and $\frac{1}{2}$, and the Whole 9, being equal to the Height.

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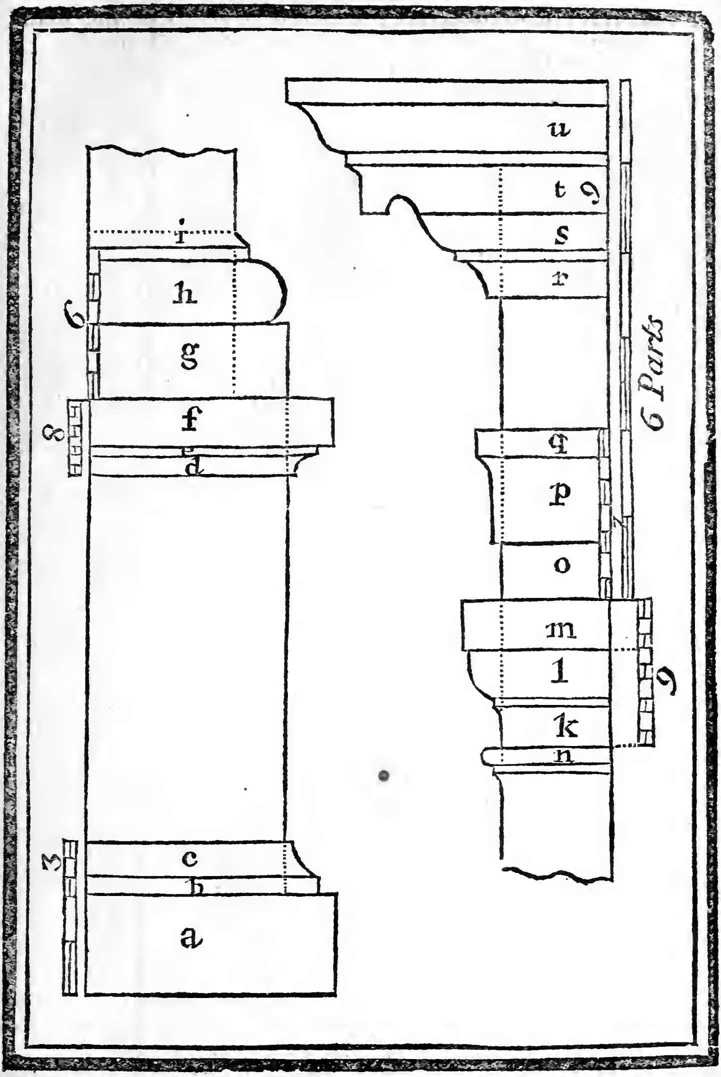
The Proportion of the TUSCAN *Order, by equal Parts.*



TUSK [in *Carpentry*] a Bevel Shoulder, made to ſtrengthen the Tenon of the Joiſt, which is let into the Girder.

TYMPAN [in *Architecture*] is the Ground or Area of a Pediment; being that which is in a Level with the Naked of the Frieze: Or it is the Space included between the three Cornices of a triangular Pediment, or the two Cornices of a circular one.

TYMPAN [in *Architecture*] is alſo the Tympan of an Arch in a trriangular Space or Table in the Corners or Sides of the Arch; uſually hollow'd or enrich'd, ſometimes with Branches of *Laurel*, *Olive-Tree* or *Oak*; or with *Trophies*, &c. ſometimes with *Flying Figures*, as *Fame*, &c. or *Sitting Figures*, as the *Cardinal Vertues*, &c.

V

VAGINA [in *Architecture*] is us'd to ſignify the lower Part of a *Terminus*, becauſe of its Reſemblance to a Sheath, out of which the Statue ſeems to iſſue.

The *Vagina* is that long Part between the Baſe and the Capital; and is found in divers Manners and with divers Ornaments.

VALLEYS [in *Building*] the Gutters over the Sleepers in the Roof of a Building.

VARNISH } VERNISH } is a thick, viſcid, ſhining Liquor, us'd by Painters, Gilders, and various other Artificers, to give a Gloſs and Luſtre to their Works; as alſo to defend them from the Weather, Duſt, &c.

There are ſeveral kinds of Varniſhes in Uſe; as the *Siccative* or *drying Varniſh*, made of Oil of *Aſpin*, *Turpentine* and *Sandarack* melted together.

White VARNISH, call'd alſo *Venetian Varniſh*, made of Oil of Turpentine, Fine Turpentine and Maſtic.

Spirit of Wine VARNISH, made of *Sandarach*, *White Amber*, *Gum Elemi* and *Maſtick*; ſerving to gild Leather, Picture-Frames, &c. withal.

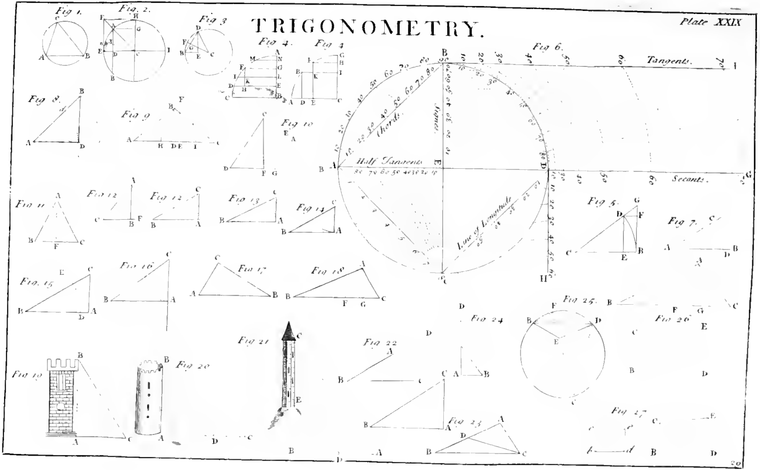
Gilt VARNISH, made of *Linſeed Oil*, *Sandarach*, *Aloes*, *Gum Gutta*, and *Litharge of Gold*.

China VARNISH, made of *Gum Lacca*, *Colophony*, *Maſtic*, and *Spirit of Wine*.

Common VARNISH, which is only common *Turpentine*, diſſolv'd in *Oil of Turpentine*.

White VARNISH } *Amber* VARNISH } From a Manuſcript of Mr. *Boyle*. Take white Roſin four Drams, melt it over the Fire in a clean glaz'd Pipkin, then put into it two Ounces of the whiteſt Amber you can get (finely powdered) this is to be put in by a little and a little, gradually, keeping it ſtirring all the while with a ſmall Stick, over a gentle Fire, till it diſſolves, pouring in now and then a little Oil of Turpentine, as you find it growing ſtiff; and continue ſo to do till all your Amber is melted.

But great Care muſt be taken not to ſet the Houſe on Fire, for the very Vapours of the Oil of Turpentine will take Fire


TRIGONOMETRY.
Plate XXIX
Fig. 1.
Fig. 2.
Fig. 3
Fig. 4.
Fig. 6.
Tangents.
Chords
Sines
Half Tangents
Secants.
Line of Longitude
Fig. 5.
Fig. 7.
Fig. 8.
Fig. 9
Fig. 10
Fig. 11
Fig. 12
Fig. 13
Fig. 14
Fig. 15
Fig. 16
Fig. 17
Fig. 18
Fig. 19
Fig. 20
Fig. 21
Fig. 22
Fig. 23
Fig. 24
Fig. 25.
Fig. 26
Fig. 27

Fire by Heat only; but if it ſhall happen ſo to do, immediately put a flat Board or wet Blanket over the fiery Pot, and by keeping the Air from it, you will put it out, or ſuffocate it.

Therefore it will be beſt to melt the Roſin in a Glaſs of a Cylindric Figure in a Bed of hot Sand, after the Glaſs has been well *anneal'd* or warm'd by Degrees in the Sand, under which you muſt keep a gentle Fire.

When the Varniſh has been thus made, pour it into a coarſe Linnen Bag, and preſs it between two hot Boards of Oak or flat Plates of Iron; after which it may be us'd with any Colours in Painting, and alſo for varniſhing them over when painted.

But for covering Gold, you muſt uſe the following Varniſh: this is to be obſerv'd, that when you have varniſh'd with white Varniſh, you may put the Things varniſh'd into a declining Oven, which will harden the Varniſh.

A *Hard* VARNISH, *which will bear the Muffle (from a Manuſcript af Mr.* Boyle's*) for laying over any Metal, that appears like Gold, to prevent it from turning black, which all but Gold will be apt to do, when expos'd to the Air.*

Take of *Colophony*, which is to be had at the Druggiſts, an Ounce; ſet it over the Fire in a well glaz'd earthen Veſſel, till it is melted; then by little and little, ſtrew in two Ounces of Powder of *Amber*, keeping ſtirring it all the while with a Stick; and when you perceive it begin to harden or reſiſt the Stick, then put in a little Turpentine Oil, which will thin and ſoften it immediately; then put in two Ounces of *Gum Copal* [finely powdered) ſprinkling it in as you did the *Amber*, ever and anon pouring in a little Oil of Turpentine, and when it is done, ſtrain it as before directed.

This is proper to varniſh over Gold, and the Things done with it, muſt be ſet into a declining Oven, three or four Days ſucceſſively, and then it will reſiſt even the Fire.

A VARNISH *for Braſs to make it look like Gold.*

This is us'd upon Leaf Gold, or upon that which is call'd *Dutch* or *German* Leaf-Gold, or upon Braſs or Bath-Metal, which are deſign'd to imitate Gold.

Take two Quarts of *Spirit of Wine*, and put it into a Retort Glaſs; then add to it an Ounce of *Gamboge*, two Ounces of *Lake*, and two Ounces of *Gum Maſtic*; ſet this in a Sand Heat for ſix Days, or elſe near a Fire, or you may put the Body of the Retort frequently into warm Water, and ſhake it two or three times a Day; then ſet it over a Pan of warm Small Coal Duſt, before you lay this Varniſh over the Metal, to be ſure you ſee that it has been well clean'd, varniſh it over thinly with this Varniſh, and it will appear of the Colour of Gold. Set it in

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a declining Oven to harden, and it will not rub off.

N.B. This is a good Varnish to mix with any Colours that incline to red, and the white Varnish for mixing with those that are pale.

A VARNISH *for Wood, Paper*, &c.

The *Japanese* have a Method of making Plates, Bowls and other Vessels of brown Paper, and sometimes of fine Saw-Dust; which Vessels are very light, and very strong, which by Reason they are not liable to be broken by a Fall as *China* Ware or Porcelaine made of Earth, are much esteem'd with us. The Method of making them is as follows.

Take brown Paper, boil it in common Water, stirring and mashing it all the while with a Stick, till it is almost become a Paste; then take it out and pound it well in a Stone Mortar, till it is reduc'd to a soft pappy Consistence, like Rags for Paper making; then with common Water and Gum Arabic, a Quantity sufficient to cover this Paper Paste an Inch, put these together in a well glaz'd Pipkin, and boil them well, keeping continually stirring them, till the Paste is well impregnated with the Gum; then is your Paste fit for making any Form you design.

Having the Mould ready made, as suppose any Thing of the Figure of a Plate, you must have hard Wood turn'd on one Side of such a Figure, with a Hole or two in the middle, quite through the Wood, to let any Water pass through that is press'd out of the Paste; which Mould must be concave and in the middle in the Form, of the underside of a Plate, also another Piece of hard Wood must also be turned convex in the middle, and in the Form of the upperside of a Plate; this must be about the eighth Part of an Inch less than the under Mould; but about the Rim or the Edge, you may, if you please, have some little Ornament carv'd or engraven in the Wood.

These Moulds must be well oil'd on the turn'd Sides, as soon as they are made, and must be continued oiling, till they have been thoroughly drench'd with Oil, and oil them well again just before you use them, to prevent the gummed Paste from sticking to the Wood; set the under Mould upon a strong Table even, and spread it over with some of your Paste as evenly as you possibly can, so as to be every where of an even Thickness of about a quarter of an Inch; then having oil'd the upper Mould, and put it as exactly as may be on the Paste, and press it hard down setting a great Weight upon it; letting it remain in that State for 24 Hours.

When you suppose the Paste to be dry, take it out of the Moulds, and when it is thoroughly dry, it will be as hard as Wood, and be fit to lay a Ground upon, made with strong Size and Lamp-black, letting

it dry gently; and when that is thoroughly dry, mix Ivory-black with the following Varniſh, and uſe it as hereafter directed.

A ſtrong Japan VARNISH.

Take an Ounce of Colophony, and melt it in a well glaz'd earthen Veſſel; then having three Ounces of Amber finely pulveriz'd and ſifted, put it in by little and little, adding now and then ſome Spirit of Turpentine; when it is thoroughly melted, ſprinkle in three Ounces of Sarcacolla, keeping it all the while ſtirring, putting in frequently more Spirit of Turpentine, till all is melted and well incorporated; then ſtrain it through a coarſe Hair Bag, plac'd between two hot Boards, and preſs it gently, receiving the Clear into a well glaz'd Pot, made warm; with this Varniſh mix the ground Ivory-Black, and having firſt warm'd the Veſſel made in the Mould, whatſoever Form it is, Plate, Bowl, *&c.* lay it on before the Fire in a warm Room, that the Air may not chill the Varniſh; lay it on equally and then ſet it into a gentle Oven; and the next Day into a hotter, and the third Day into one that is very hot, letting it ſtand in it till the Oven is quite cold, and then it will be fit for any Uſe, either for Liquors cold or hot, and will never change, nor can they be broken but with great Difficulty.

As for the Moulds, it is probable they might do as well if they were caſt of any hard Metal, as if turn'd of Wood.

You may alſo make what Things you pleaſe of fine Saw-duſt, by drying it well, and pouring on it ſome Turpentine; having an equal Quantity of Roſin melted with it, and half the Quantity of Bees-wax, mix them well together, and put them to the dry Saw-duſt, ſtirring all together till the Mixture becomes thick as a Paſte; then take it off the Fire, and having warm'd your Moulds, ſpread ſome of the Mixture on the under Mould, that has a Hole in the Middle, as equally as poſſible, and preſs the upper Mould upon it, as before; let it ſtand to cool, and your Veſſel will be fit for painting.

There may, if you pleaſe, be ſome *Sarcacolla* finely powdered; put into this while your Turpentine is melting, to the Quantity of half the Turpentine; ſtirring it well, and it will harden it: This Varniſh will moſt ſafely be made in the open Air, becauſe it will endanger the Houſe, and have a wet Cloth ready to put it out, if it takes Fire.

But which ever of the Mixtures you uſe, if you have a mind to have them appear like Gold, do them over with Gold Size, and when that begins to ſtick a little, with the Finger, lay on Leaf Gold, either real Gold, or that which is brought from *Germany*; but the laſt is apt to change green, as moſt of the Preparation from Braſs will do; ſuch as thoſe which are call'd Bath-metal, and others

thers of the like Sort, which appear like Gold, when they are fresh polish'd, or clean'd every Day; but as the Air coming upon them will make them alter to another Colour, Gold itself is rather to be chosen, which is durable, and will never change, and is also a much finer Colour than any of the former for a Continuance.

And altho' the Leaf Gold is tender, and may be supposed to be liable to rub off, yet the Varnish with which it is to be varnish'd over, will keep it bright and intire.

When the Leaf Gold has been laid on, and the flying Pieces brush'd off, which is not to be done till the Gold Size is dry, then varnish it over with the following Varnish.

VARNISH *for Gold, or such Leaf of Metals that imitate Gold.*

Take Colophony, and having melted it, put in two Ounces of Amber, finely powdered, and some Spirit of Turpentine, and as the Amber thickens, keep it well stirring; then put in an Ounce of Gum Elemi, well pulverised, and more Spirit of Turpentine, constantly stirring the Liquor till all is well mix'd and incorporated: But take care however to use as little Turpentine as you can; because the thicker the Varnish is made, the harder it will be. Let this be done over a Sand-Heat, in an open Glass, then strain it, as is directed for the preceeding Varnish. This Varnish is to be used alone; first warming the Vessels made of Paper Paste, and lay it on with a painting Brush before the Fire, but not too near, least the Fire raise it into Blisters: After this has been done, harden it three several Times in Ovens; first with a slack Heat, the next with a warmer, and the third with a very hot one; and the Vessels will look like polish'd Gold.

And as for such Vessels, *&c.* as shall be made with Saw-dust and Gums; the Varnish may be made of the same Ingredients as above-mentioned, except the Gum Elemi; and this will dry in the Sun, or in a gentle Warmth.

To varnish of a Red Colour.

After what you would varnish has been prepared as before, and are thoroughly dry, mix Vermilion with the third Varnish, and use it warm; then stove it, or harden it by Degrees in an Oven; and it will appear very glossy, or else lay on your first Ground with Size and Vermilion, and in proper Places you may stick on with Gum Arabick, and water some Figures cut out of Prints, as little Sprigs of Flowers, or such like, and when they are dry, paint them over with Gold Size, and let that remain, till it is a little sticky to the Touch; then lay on your Gold, and let that be well clos'd to the Gold Size, and dried. See the Article *Gilding*. Then if you would shade any Part of your Flower, take some Ox-gall, and with a fine Camels

Camels Hair Pencil, trace over the ſhady Parts on the Leaf-Gold, and with deep *Dutch* Pink; and when that is dry, uſe your Varniſh in a warm Place (I mean that Varniſh directed for the Covering of Gold) and ſet it to harden by degrees in an Oven, which Varniſh will ſecure the Leaf Gold; altho' it be only that called *Dutch* Gold, or Metal, from changing by keeping the Air from it.

Varniſhing any Thing which is covered with Leaf Silver.

Firſt paint the Thing over with Size, and ground Chalk or Whiting; let them ſtand till they are thorougly dry, and then do them over with very good Gold Size, of a bright Colour (for there is much Difference in the Colour of it; ſome being yellow, and others almoſt white; the firſt is moſt proper for Gold, and the laſt for Silver). When this Size is almoſt dry, that it will juſt ſtick a little to the Touch, lay on the Leaf Silver, and cloſe it well to the Size. See the Article *Gilding*.

A VARNISH *for covering Silver.*

Melt in a well glaz'd Pipkin, ſome fine Turpentine, and put in three Ounces of white Amber, finely powdered (more or leſs, according to the Quantity your Work will require) put it in by little and little, keeping it continually ſtirring, adding by Degrees ſome Spirit of Turpentine, till all the Amber is diſſolved, and then add to it an Ounce of *Sarcacolla* well beaten, and an Ounce of Gum *Elemi* well levigated, adding now and then a little Spirit of Turpentine, till all is diſſolved: do this over a gentle Fire, and keep it conſtantly ſtirring.

This Varniſh will be white and ſtrong as the former, and is to be uſed warm, and hardened by degrees in an Oven, as varniſhed Gold, and it will look like poliſhed Silver.

VARNISH *for Wood, to mix with ſeveral Colours.*

Take Spirit of Turpentine, and diſſolve in it a little Gum *Taccamahacca* over the Fire, till it is a little thickened; and this may be uſed with any Colour, that has been well ground with Water, and afterwards reduced to a fine Powder. When the Work is done, you may, if you pleaſe, varniſh over your Piece, with the ſame Varniſh directed for Silver and Wood, Tables, Tea-Boards, or any Thing elſe, may be done in the ſame Manner, as is directed for Veſſels made of the Paſte of Paper and Saw-duſt.

Varniſhing Prints, &c. with white Varniſh ſo as to bear Water and Poliſhing.

The Print ſhould be firſt paſted either on Board or ſhock Cloth, ſtrained on a Frame; in order to do this well, prepare ſome ſtiff Starch; and with a Spunge dipt in Water, or thin

Starch (without any Blue in it) wet the Back of your Print, and if you design to lay it on a board, dip a large Brush in thick Starch, and brush it over the Board as even as possible, and let it dry (or you may lay a Ground of Whiting and Size on the Board first, which will do very well) then repeat it a second Time, and so continue till the Veins or Grain of the Wood is quite filled.

In the last Operation, when the Starch is just laid on, lay your wet Print upon it, as smooth as possible, that there be no Wrinkles, nor Bubbles in it, and press it on close every where, till it lies smooth, and so set it by to dry, which it will be, and fit to varnish in 24 Hours with the following Varnish.

Take *Ichyocolla*, or *Fish-glue*, or *Isinglass*, two Ounces, and after you have pulled it into small Pieces, boil it in a Pint of Brandy or strong Spirits in a well glaz'd earthen Vessel, till it comes to a strong Glue, which you may know by taking out a little, and exposing it to the Air; it is then fit for your Purpose; but don't fail to make it as strong as you can.

And while it is hot, with a large Brush, brush over the Print as quick as you can, and as smooth and even as may be, set it by for a Day or two, and then do it over again with the same Varnish or Glue, and let it dry again very well; then brush it over with white Varnish at such a Distance from the Fire, that it may not blister; repeat this two or three Times; then let it stand for a Day or two, and then varnish it over again with the white Varnish the third Time, with two or three Passages of the Brush, then let it stand for three or four Days, and it will be hard enough to be polished, which is to be done with a soft Linnen Cloth and some *Tripoli*, rubbing it very gently, till it is as smooth as may be, and afterwards clear it with Flour and Oil; and then it will appear as clear as Glass; and if at any Time it is sullied with Fly-Shits, you may clean it, by washing it with a Spunge and Water.

The white VARNISH.

Take Gum Sandarach of the clearest and whitest Sort, eight Ounces, Gum Mastick of the clearest Sort, half an Ounce, of *Sarcacolla* the whitest, three Quarters of an Ounce, *Venice* Turpentine an Ounce and a half, Benzoin the clearest one Quarter of an Ounce, white Rosin one Quarter of an Ounce, Gum *Animæ* three Quarters of an Ounce. Let all these be dissolved, and mixt in the Manner following.

Put the *Sarcacolla* and Rosin into a little more Spirits than will cover them to dissolve; then add the Benzoin, Gum *Animæ* and *Venice* Turpentine, into either a Glass or glaz'd earthen Vessel, and pour on as much Spirits as will cover them an inch; then put the Gum Mastick into a Glass

or

or glaz'd Veſſel, and pour ſtrong Spirits upon them, covering them alſo about an Inch thick, to diſſolve them rightly; then put your Gum *Elemi* in a diſtinct Veſſel as before, and cover it with Spirits to diſſolve.

For this Purpoſe, you need only break the Roſin a little, and powder the Gum *Animæ*, *Sarcacolla* and *Benzoin*.

Let all ſtand three or four Days to diſſolve, ſhaking the Glaſſes, *&c.* two or three times a Day, and afterwards put them all together into a glaz'd Veſſel, ſtirring them well, and ſtrain the Liquor and Gums gently; beginning with the Gums, through a Linnen Cloth.

Then put it into a Bottle, and let it ſtand a Week before you uſe it, and pour off as much of the clear only, as you think ſufficient for preſent Uſe.

To paſte Prints upon Cloth for Varniſhing.

If the Print be put upon a ſhock Cloth, well ſtrained in a Frame, bruſh the Cloth over with ſtrong Paſte, made with Flour and Water, and immediately bruſh over the back of the Print with well prepar'd Starch; and then bruſh the Cloth over with the ſame Starch, and lay on the Print as ſmooth as poſſible, without leaving any Wrinkles or Bubbles in the Paper. This you ſhould take Notice of, that when you have laid your Paper upon the Cloth, they will both together appear flagging, and unſtrained; but aſſoon as they are dry, all will be ſmooth, as either of them was at firſt.

Let them ſtand ſo in a dry warm Place for a Day or two, and then you may varniſh your Print as before directed, with Glue made of *Icthyocolla*, and then with the white Varniſh.

With this Varniſh you may mix up any Colour, that has been ground dry, with a Marble, and paint it upon any Figure you have drawn, or upon any Print you have paſted upon your Work; but the varniſhed Colours ſhould be chiefly put upon the ſhady.

VARNISH *made with Seed* Lacca.

Take a Pint of ſtrong Spirit of Wine, put into a Glaſs Veſſel, and put to it three Ounces of Seed *Lacca*, and let them ſtand together for two Days, ſhaking them often, then paſs it through a Jelly Bag, or a Flannel Bag, made like what is called *Hypocrates*'s Sleeve, letting the Liquor drop into a well glaz'd Veſſel, and giving the Gums a Squeeze every now and then; when the Varniſh is almoſt out of the Bag, add more, and preſs it gently till all is ſtrained, and the Dregs remain dry.

Be ſure you do not throw the Dregs into the Fire, for they will endanger ſetting the Houſe on Fire.

Put the Varniſh up in a Bottle, and keep it cloſe ſtopt, ſetting it by, till all the thick Parts are ſettled to the Bottom, which they will do in three or four

Days, then pour off the clear into a fresh Bottle, and it will be fit for Use.

As for Varnish made of *Shell-Lacca*, it is not of any great Service, tho' so often recommended, for it will not bear the Polish.

When you lay on your Varnishes, take the following Method.

1. If you varnish Wood, let your Wood be very smooth, close grain'd, free from Grease, and rubb'd with Rushes.

2. Lay on your Colours as smooth as possible, and if the Varnish has any Blisters in it, take them off by a Polish with Rushes.

3. While you are varnishing, keep your Work warm, but not too hot.

4. In laying on your Varnish, begin in the Middle, and stroke the Brush to the Outside, then to another extreme Part, and so on till all be covered; for if you begin at the Edges, the Brush will leave Blots there, and make the Work unequal.

5. In fine Works use the finest *Tripoli* in polishing: do not polish it at one Time only; but after the first Time, let it dry for two or three Days, and polish it again for the last Time.

6. In the first polishing you must use a good deal of *Tripoli*; but in the next a very little will serve; when you have done, wash off your *Tripoli* with a Spunge and Water; dry the Varnish with a dry Linnen Rag, and clear the Work, if a white Ground, with Oil and Whiting; or if black, with Oil and Lamp-Black.

An Useful VARNISH.

Take drying Linseed Oil, set it on the Fire, and dissolve in it some good Rosin, or (which is better, but dearer) Gum-lacca; let the Quantity be such as may make the Oil thick as a Balsam. When the Rosin or Gum is dissolved, you may either work it off it self, or add to it some Colour, as Verdigrease, for a green; or Amber, for an Hair Colour; or Indico and White, for a light Blue.

This will secure Timber-work done over with it, equal to painting with Colours in Oil, and is much more easy to obtain; for Linseed Oil and Rosin are more easily melted together, by boiling, than Colours can any ways be ground; and being of the Consistence of a Balsam, works very readily with a Brush, and of it self, without the Addition of Colours; bears a Body sufficient to secure all manner of Timber Work, equal to most Oil Colours.

In the working of it, there's no great Skill required, if you can but use a Painter's Brush; only let the Matter you lay it on, be thoroughly drenched, that the Outside may be glaz'd with it: And if you desire a Colour on the Outside, you need only grind a Colour with the last Varnish you lay on.

To preserve bright Iron-work from Rust, and other Injuries of a corroding Air, by an oily Varnish.

Take good *Venetian*, or for want of that the beſt and cleareſt common Turpentine, diſſolve it in Oil of Turpentine, and add to it ſome Linſeed Oil, made clear by long ſtanding in the hot Sun (for ſome uſes the common drying Linſeed Oil may ſerve;) mix them well together, and with this Mixture varniſh over any Sort of bright Iron-work whatſoever.

It is a certain Preſerver of all ſuch Iron-work from Ruſt, let it be what it will, provided it be ſuch as is not brought into common Uſe,' for much handling will wear it off, and Heat will diſſolve it; but for all ſuch bright Iron-work that is uſed about either Carpenters or Joiners Work, that require not much handling; as alſo Arms, &c. that hang up for State, rather than preſent Uſe, it is an infallible Preſervative.

When you uſe this oily Varniſh, 'tis beſt to warm it, and then with a Bruſh lay it on as thin as poſſible; this is beſt for Arms; but for other Iron-work, it may be laid on cold; in four or five Days after it has been laid on, it will be thoroughly dry.

Note, That ſuch Arms as have been done over with it, may when they come into uſe be cleanſed from it again, by being warmed hot before a Fire: for Heat will diſſolve it, but Water will do it no Hurt.

VASES [in *Architecture*] are certain Ornaments placed on Cornices, Socles or Pedeſtals; repreſenting the Veſſels of the Ancients; particularly thoſe uſed in Sacrifices, as Incenſe Pots, Flower-Pots; all which are occaſionally enrich'd with *Baſſo Relievo's*.

They are uſually placed there to crown or finiſh Facades, or Frontiſpieces.

Vitruvius ſpeaks of a Sort of Theatrical Vaſes made of Braſs, or earthen Ware, which were diſpoſed in private Places, under the Steps and Seats of the Theatres, to aid and increaſe the Reflection and Reſonance of the Actors Voices, &c.

It is ſaid there are of theſe Sort of Vaſes in the Cathedral Church of *Milan*.

VASE is particularly uſed in Architecture, to ſignify the Body of the *Corinthian* and Compoſite Capital, and is called the Tambour or Drum, and ſometimes the *Campana*.

VAULT [in *Architecture*] is a Piece of Maſonry-Arch without Side, and ſupported in the Air by the Artificial placing of the Stone which forms it, its principal Uſe being for a Cover or Shelter, or it is an arch'd Roof, ſo contriv'd, as that the ſeveral *Vouſſoirs* or Vault-Stones, of which it conſiſts, do, by their Diſpoſition ſuſtain each other. Vaults are to be preferred on many Occaſions to *Soffits* or flat Cielings, as they give a greater Riſe and Elevation, and beſides are more firm and durable.

Salmasius obſerves, that the Ancients had only three kinds of Vaults. The fiſt was the *Fornix* made Cradle-wiſe; the ſecond, a *Teſtudo*, i. e. *Tortoiſe-*wiſe, which the *French* call *Cul de Four* or *Oven-wiſe*; and the third, *Concha*, or Trumpet-wiſe.

But the Moderns have ſubdivided theſe three Sorts into many more, to which they have given different Names, according to their Figures and Uſes, ſome of them are circular and others eliptical.

Again, the Sweeps of ſome are larger, others leſs Portions of a Sphere. All ſuch as are above Hemiſpheres are called *High* or *ſurmounted Vaults*; and all that are leſs than Hemiſpheres, are called *Low* or *ſurbaſed Vaults*, or *Teſtudines*.

In ſome *Vaults* the Height is greater than the Diameter; in others, it is leſs: others again are quite flat, and only made with Haunſes, others like Ovens, or in the Form of a *Cul de Four*, &c. and others growing wider as they lengthen, like a Trumpet.

There are alſo *Gothick Vaults*, with *Ogives*, &c.

Of *Vaults* ſome again are *ſingle*, others *double*, *croſs*, *diagonal*, *horizontal*, *aſcending*, *deſcending*, *angular*, *oblique*, *pendent*, &c.

Maſter Vaults are thoſe that cover the principal Parts of Buildings, in contradiſtinction to the upper or ſubordinate *Vaults*, which only cover ſome little Part, as a Paſſage or Gate, &c.

A *double Vault* is one that is built over another, to make the outer Decoration range with the inner, or to make the Beauty and Decoration of the Inſide, conſiſtent with that of the Outſide, leaves a Space between the Concavity of the one, and the Concavity of the other. Inſtances of which, we have in the Dome at St. *Peter*'s at *Rome*, St. *Paul*'s in *London*, and in that of the Invalids at *Paris*.

Vaults, with Compartments, are ſuch whoſe Sweep, or inner Face is enrich'd with Pannels of Sculpture, ſeparated by Platbands. Theſe Compartments, which are of different Figures, according to the Vaults, and uſually gilt on a white Ground, are made with Stone or Brick-walls; as in the Church of St. *Peter* at *Rome*, or with Plaiſter on Timber Vaults.

Theory of Vaults.

A Semi-circular Arch or Vault, ſtanding on two Piedroits, or Impoſts, and all the Stones that compoſe them, being cut, and placed in ſuch Manner, as that their Joints or Beds being prolonged, do all meet in the Centre of the Vault; it is evident, that all the Stones muſt be in the Form of Wedges, *i. e.* muſt be wider and bigger at Top, by virtue of which they ſuſtain each other, and mutually oppoſe the Effort of their Weight, which determines them to fall.

The Stone in the middle of the Vaults, which ſtands perpendicular

pendicular to the Horizon, and is called the *Key* of the Vault, is ſuſtained one each Side by two contiguous Stones, juſt as by two inclin'd Planes; and conſequently the Effort it makes to fall, is not equal to its Weight.

But ſtill that Effort is the greater, as the inclin'd Planes are leſs inclin'd; ſo that if they were infinitely little inclin'd, *i. e.* if they were perpendicular to the Horizon, as well as the Key, it will tend to fall with its whole Weight, and would actually fall, but for the Mortar.

The ſecond Stone, which is on the right or left of the *Key-Stone*, is ſuſtained by a third, which by virtue of the Figure of the Vault, is neceſſarily more inclined to the ſecond, than the ſecond is to the firſt; and conſequently the ſecond, in the Effort it makes to fall, employs a leſs Part of its Weight than the firſt.

For the ſame Reaſon, all the Stones from the *Key-Stone*, employ ſtill a leſs and leſs Part of their Weight to the laſt; which reſting on a horizontal Plane, employs no Part of its Weight; or which is the ſame Thing, makes no Effort at all, as being intirely ſupported by the Impoſt.

Now in *Vaults*, a great Point to be aimed at, is, that all the *Vouſſoirs* or Stones make an equal Effort towards falling: To effect this, it is viſible, that as ſuch (reckoning from the *Key* to the Impoſt) employ ſtill a leſs and leſs Part of its whole Weight; the firſt, for Inſtance only employing one half, the ſecond, one third, the third one fourth, &c. There is no other way of making thoſe different Parts equal, but by a proportionable Augmentation of the whole, *i. e.* the ſecond Stone muſt be heavier than the firſt, the third than the ſecond, &c. to the laſt; which ſhould be infinitely heavier.

M. *de la Hire* demonſtrates what that Proportion is, in which the Weights of the Stones of a Semi-circular Arch muſt be increaſed to be *in Equilibrio*, or to tend with equal Forces to fall, which is the firmeſt Diſpoſition a Vault can have.

The Architects before him had no certain Rule to conduct themſelves by, but did all at Random. Reckoning the Degrees of the Quadrant of a Circle, from the Key-ſtone to the Impoſt, the Extremity of each Stone will take up ſo much the greater Arch, as it is farther from the Key.

M. *de la Hire*'s Rule is to augment the Weight of each Stone above that of the Key-ſtone, as much as the Tangent of the Arch of half the Key.

Now the Tangent of the laſt Stone of Neceſſity becomes infinite, and of conſequence its Weight ſhould be ſo too; but as Infinity has no Place in Practices, the Rule amounts to this, that the laſt Stones be loaded as much as poſſible, that they may the better reſiſt the Effort which the Vault makes to ſeparate them; which is call'd the Shoot or Drift of the Vault.

Mr. *Parent* has since determined the Curve or Figure, which the *Extrados* or Outside of a Vault, whose *Intrados* or Inside is spherical, must have that all the Stones may be *in Equilibrio*. See *Bridges*.

The Key of a Vault is a Stone or Brick in the middle of the Vault, in Form of a truncated Cone; which serves to bind or fasten all the rest.

The Reins of a Vault, or the filling up are the Sides which sustain it.

The Pendentive of a Vault is the Part suspended between the Arches or *Ogives*.

The Impost of a Vault is the Stone on which the first *Voussoir* or Stone of the Vault is laid.

VELOCITY [in *Mechanicks*] *i. e.* Swiftness, is that Affection of Motion, whereby a Moveable is disposed to run over a certain Space in a certain Time.

The greatest Velocity wherewith a Ball can descend, by virtue of its specifick Weight, in a resisting Medium, is that which the same Ball would acquire by falling in an unresisting Medium thro' a Space, which is to be four Thirds of its Diameter, as the Density of the Ball to the Density of the Fluid. *Huygens*, *Leibnitz*, *Bernouli*, and other foreign Mathematicians, hold, that the *Momenta*, or Forces of falling Bodies, at the End of their Falls, are as the Squares of their Velocities into the Quantities of Matter. On the contrary, the *English* Mathematicians maintain them to be as the Velocities themselves into the Quantities of Matter. Velocity is conceived to be either absolute or relative: The Velocity which has been already considered is simple or absolute, in respect to a certain Space, mov'd in a certain Time.

Relative or respective Velocity, is that wherewith two distant Bodies approach each other, and come to meet in a longer or less Time; whether only one of them moves towards the other at rest, or whether they both move; which may happen two ways, either by two Bodies mutually approaching each other in the same right Line, or by two Bodies moving the same Way in the same Line, only the foremost slower than the other; for by this means this will overtake that, and as they come to meet in a greater or less Time, the relative Velocity is greater or less.

Thus if two Bodies come nearer each other by two Feet, in one second of Time; their respective Velocity is double that of two others, which only approach one Foot in the same Time.

VENEERING } is a Sort
VANEERING } of Marquetry, or inlaid Work, whereby several thin Slices, or Leaves of fine Woods of different Kinds, are applied and fastened on a Ground of some common Wood.

There are two kinds of inlaying; the one which is the more ordinary, goes no farther than

than the making Compartments of different Woods; the other requires a great deal more Art, and represents Flowers, Birds, and the like.

The first kind is what we properly call Veneering, the latter is described under the Article Marquetry.

The Wood intended for Veneering is first sawed out into thin Slices or Leaves, about a Line thick; in order to saw them, the Blocks or Planks are placed upright, in a kind of Sawing Press.

These Slices are afterwards cut into narrow Slips, and fashioned divers ways, according to the Design proposed: After this the Joints are carefully adjusted, and the Pieces brought down to their proper Thickness, with several Plans for that Purpose; then they are glued down on a Ground or Block of dry Wood, with good strong *English* Glue.

The Pieces being thus jointed and glued, the Work, if small, is put into a Press; if large, it is laid on a Bench covered with a Board, and press'd down with Poles or Pieces of Wood, one End of which reaches to the Cieling of the Room, and the other bears on the Board.

When the Glue is thoroughly dry, they take it out of the Press and finish it; first with little Planes, afterwards with divers Scrapers; some of which resemble Rasps which take off the Dents, *&c.* left by the Planes.

When the Work has been sufficiently scraped, it is polished with the Skin of a Sea-dog, Wax and a Brush, and a Polisher of Shave-grass; which is the last Operation.

VENTIDUCTS [in *Building*] ar Spiracles or subterraneous Places, where fresh cool Winds being kept, are made to communicate, by means of Ducts, Funnels, or Vaults, with the Chambers or other Apartments of an House, to cool them in sultry Weather. These are called by the *Italians*, *Ventidetti*, and by the *French*, *Prisons des Vents*, and *Palais d'Eole*.

VERDEGREASE is the best and most useful green of all others; this Colour is made out of Copper, being no other than the Rust of that Metal, promoted by the Fumes of sour Wine, and the Rape of Grapes; the Process of which, as it is perform'd at *Montpelier*, in *France* (where the best is said to be made) as may be seen in Mr. *Ray*'s Travels, *pag.* 454. It is a delicate Green inclining to a bluish; but with a little Pink-yellow, makes the delicatest Grass-green in the World, It is a Colour that will grind very fine; but not without some Pains; and when ground fine, it lies with a good Body, and works well.

They have at the Colour-shops a Sort of it, that they call distill'd Verdegrease, being that which is perfectly purified from Dross and Filth, of good Use in fine Work, but too dear for common Painting.

Green VERDITER is a ſandy Colour, and does not bear a good Body, and is ſeldom uſed but in Landskip, where Variety is required. It ſhould be waſhed before uſed. See waſhing of *Colours.*

Blue VERDITER is ſomething ſandy, of no very good Colour, of it ſelf, nor no good Body, being apt to turn greeniſh; but being mix'd with yellow, makes a good green. It ought to be waſhed before uſed. See waſhing of *Colours.*

VERMILION is the moſt delicate of all light Reds, being of it ſelf a perfect Scarlet Colour; it is made artificially out of Quick-ſilver and Brimſtone, in the manner following.

Take ſix Ounces of Brimſtone, and melt it in an Iron Ladle, then put two Pound of Quick-ſilver into a ſhammy Leather, or double Linnen Cloth, and ſqueeze it out into the melted Brimſtone, ſtirring them, in the mean Time, with a wooden *Spatula* till they are well united; and when they are cold, beat the Maſs into a Powder, and ſublime it in a Glaſs-veſſel, with a ſtrong Fire, and it will riſe into that Red Subſtance, which is called artificial Cinnabar or] Vermilion. The whole Proceſs may be ſeen more at large in *Lemery*'s Chymiſtry.

This Colour is of a delicate fine Body, and if Pains be beſtowed on it, it will grind as fine as the Oil it ſelf, and then it makes a moſt excellent Colour: But if it be not ground very fine, the Glory of it will not appear; for it will look dull, and work coarſe; but if it be ground very fine, no Colour in the World looks better or works ſmoother, nor bears a better Body than Vermilion does, nor goes farther.

VERTEX the Top of any Thing, as the Vertex of a Cone, Pyramid, Conick Section, *&c.*

VERTEX [of a Glaſs in Opticks] is the ſame with the Pole of the Glaſs.

VESTIBLE [in *Architecture*] a kind of Entrance into large Buildings; being an open Place before the Hall, or at the Bottom of the Stair-Caſe.

VESTIBLES only intended for Magnificence, are uſually between the Court and the Garden: Theſe are ſometimes *ſimple, i. e.* have their oppoſite Sides equally enrich'd with Arches; and ſometimes their Plan is not contained under four equal Lines, or a circular one, but forms ſeveral *Van Corps,* and *Rear Corps,* furniſhed with Pilaſtets, *&c.*

The *Romans* had Places called Veſtibles, at the Entrance of their Houſes, for the Shelter of thoſe Perſons who were obliged to ſtand at the Door. And we have now Veſtibles of the like Kind in many old Churches, Houſes, *&c.* called *Porches.*

Martinius derives the Word from *Veſtæ ſtabulum,* by reaſon that the Fore-part of the Houſe was dedicated to *Veſta,* and others ſay, becauſe it was uſual for People to ſtop in the Veſtible before they went in Doors.

Daviler derives it from *Vestis*, a Garment, and *ambulare*, to walk, because the *Vestible* in the modern Houses being an open Place at the Bottom of a large Stair-case, serving as a Thorough-fare to the several Parts of the house; here they first let fall their Trains in Visits of Ceremony.

Vestible is also sometimes used to signify a little kind of Antichamber before the Entrance of an ordinary Apartment.

VIBRATION [in *Mechanicks*] is a regular, reciprocal Motion of a Body, *e. gr.* of a Pendulum; which being suspended at Freedom, swings or vibrates first this Way, and then that.

For the Bob being raised, falls again by its Gravity, and with the Velocity thus acquir'd, rises to the same Height on the other Side; from whence its Gravity makes it fall again; and thus its Vibrations are continued.

Mechanical Authors, instead of Vibration, frequently use the Term *Oscillation.*

The Vibrations of the same Pendulum are all *Isochronal*, *i. e.* they are performed in equal Time, at least in the same Climate; for towards the Equator they are somewhat slower.

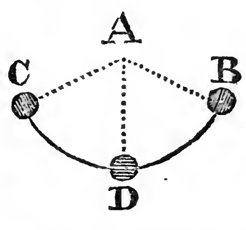
A Pendulum three Foot three Inches, and two Tenths of an Inch, according to *Huygens*, or 39.25 Inches, according to Sir *John Moor* and Lord *Brouncker*, vibrates Seconds, or makes 3600 *Vibrations* in an Hour.

The *Vibrations* of a longer Pendulum take up more Time than those of a shorter one, in a sub-duple *Ratio* of the Lengths.

Thus a Pendulum three Foot long, will make 10 *Vibrations*, while another nine Inches long, makes 20: for 10 is the half of 20, and three Feet, or 36 Inches, are the Square of six Inches, which is the double of three, whose Square is nine: So that 10 is to 20 in a sub-duple *Ratio* of 36 to 9.

The same is meant, when we say, that the Number of *Vibrations* of *Pendulums* in a given Time, is in a reciprocal *Ratio* of their Lengths.

VIBRATION is the circular Motion of a Body, as B or C swinging on a Line, &c. fastened at A as a Center, which Point A is called the Center of Motion, and by some, the Center of reciprocal Motion; the Point D is called the Point of Rest, and a Line A B is called the Pendulum.



A is called the Center of reciprocal Motion, because when the Pendulum A D is moved from the Point of Rest D to C, it moves about that Point A to return to D, first on the one Side, and then on the other, until by its own Gravity, it

 ceases

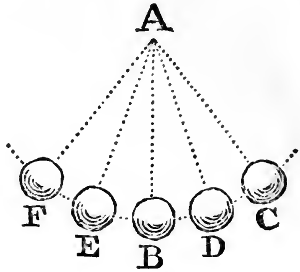
ceases its Motion, and remains in D the Point of Reſt : wherefore 'tis called the Center of reciprocal Motion.

Vibration is either *ſimple* or *compound* ; that is *ſimple*, when the Pendulum has moved from B to C, and *compound* when it has returned back again from C to B, *&c.*

Pendulums of equal Lengths and Weights, perform their Vibrations very near in the ſame Time ; but *Pendulums* of different Lengths will vibrate unequally, becauſe a longer *Pendulum* muſt remove more Air in its Swing or Vibration than a ſhorter.

It has been found by ſeveral Experiments, that the Length of two unequal Pendulums are reciprocally proportionable to the Squares of the Numbers of their Vibrations ; that is the Length of the firſt Pendulum : is to that of the ſecond : : as the Square of the Numbers of the Vibrations of the ſecond : in a given Time : is to the Square of the Numbers of the Vibrations of the firſt in the ſame Time.

Mr. *Henry Philips* in his Advancement of the Art of Navigation, affirms, That if a Pendulum be made = 38 Inches and a half from A the Center of Motion, to C the Center of Gravity of a Bullet, *&c.* every Vibration of ſuch a Pendulum will be = one Second or both Parts of a Minute of Time : that is every Time that the Body C or D paſſes by the Point of Reſt B, either from B to C, and back again to B, or by the Point of Reſt B, either from B to C, and back again to B, or from B to F, and back again to B, will be = one Second of Time, and conſequently its Motion from C to B, or from B to F, *&c.* muſt be = half a Second of Time.



Here it is to be obſerved, that it is no Matter what Swing or Diſtance from the Point of Reſt you firſt give it ; for a Body will vibrate in the ſame Time from C to F, as from D to E.

Therefore if ſeveral Pendulums of equal Lengths and Weights were ſet going together at the ſame Time, with Difference, at firſt they would be all in perpendicular Poſition, as A B at the ſame Time.

For tho' the Body C, being raiſed higher from B than the Body D, will vibrate with greater Velocity than the Body D, which is raiſed but half the Height of C. Yet if both Sides are ſet going at the ſame Time, they will paſs by the Point of Reſt at the ſame Time, their Velocity being proportionable to the Spaces through which they paſs.

This is plain; for as the Body D vibrates but to E, which is but half the Arch C F, thro' which the Body C vibrates at the ſame Time: therefore the Body D requires but half the Velocity of the Body C, *&c.*

VICE [in *Smithery*, &c.] is a Machine or Inſtrument ſerving to hold faſt the Pieces to be filed, bent, riveted, *&c.*

The Parts of the Vice are the Plane, which is its uppermoſt Part; the Chaps which are cut with Baſtard Cut, and well tempered; the Screw-pin, cut with a ſquare ſtrong Worm; the Nut or Screw-box, which has a ſquare Worm, and is braz'd into the round Box, the Spring which throws the Box open, and the Foot on which the whole is mounted.

VICE [with Glaziers] a Machine for turning or drawing Lead into flat Rods, with Groves on each Side, to receive the Edges of the Glaſs.

VISION [in *Opticks*] the Laws of Viſion brought under Mathematical Demonſtration, make the Subject of Opticks taken in the greateſt Latitude of that Word: for among the Writers of Mathematicks, Opticks is moſt generally taken in a more reſtrained Signification for the Doctrine of direct Viſion; Catoptricks for the Doctrine of reflected Viſion; and Dioptricks for that of refracted Viſion.

Direct VISION } Simple VISION } is that which is performed by means of direct Rays; that is of Rays paſſing directly, or in right Lines, from the radiating Point to the Eye.

Reflected VISION is that which is performed by Rays reflected from *Specula* or Mirrours.

Refracted VISION is that which is performed by Means of Rays refracted or turned out of their Way, by paſſing thro' Mediums of different Denſity, chiefly thro' Glaſſes and Lenſes.

VISUAL RAYS are Lines of Light imagined to come from the Object to the Eye.

VISUAL Point [in *Perſpective*] is a Point in the horizontal Line, wherein the ocular Rays unite. Thus a Perſon who ſtands in a ſtraight long Gallery, and looking forwards, the Sides, Floor and Cieling ſeem to meet, and touch one another in a Point or common Center.

VIVO [in *Architecture*] the Shaft or Fuſt of a Column; it is alſo uſed for the naked of a Column.

UMBER is a Colour of great Uſe in vulgar Painting; it is an Earth or Mineral dug out of a certain Iſland in the Mediteranean Sea, being of the Complexion of that which among us is called a Hair Colour; it grinds very fine, and bears the beſt Body of any earthy Colour, now in uſe, and when burnt, becomes the moſt natural Shadow for Gold of all others, and with a Mixture of white, it reſembles the Colour of new Oaken Wainſcot; it dries quickly and with a good Gloſs.

Umber if it be intended for the Colour of a Horſe, or a Shadow for Gold, then burning fits it for that Purpoſe, by making it darker.

It muſt only be put into the naked Fire in large Lumps, and not taken out till they be thoroughly red hot, or you may, if you pleaſe incloſe it in a Crucible, and then put it into the Fire till it be red hot, and then take it out, and when cold lay it by for Uſe.

UNDER PINNING [in *Building*] ſignifies the bringing it up with Stone under the Groundſells. Sometimes it is uſed to ſignify the Work itſelf when it is done.

[*The Price of doing it.*] The Price in ſeveral Parts of *Suſſex* (for the Workmanſhip only) in ſome Parts of *Kent*, is 1 *d.* $\frac{1}{2}$ *per* ſuperficial Foot, and in *Suſſex* 1 *d. per* Foot.

In ſome Places, 'tis the Cuſtom in meaſuring it, to take in half the Shell into their Meaſure.

UNGULA [in *Geometry*] is the Section of a Cylinder cut off by a Plane, paſſing obliquely through the Plane of the Baſe, and Part of the Cylindrical Surface.

VOLUTE [in *Architecture*] is a Sort of Scroll or Spiral Contortion uſed in the *Ionick* and compoſite Capitals, of which it is the principal Character, and Ornament.

It is by ſome called the *Ram's horn*, from the Reſemblance of the Figure thereto.

Moſt Architects are of the Opinion, that it was deſigned by the Ancients, to repreſent the Bark or Rind of a Tree laid under the *Abacus*, and twiſted thin at each Extreme where it is at Liberty: others ſuppoſe it to be a Sort of a Pillow or Bolſter laid between the *Abacus* and *Echinus*, to prevent the latter from being broke by the Weight of the former, and the Entablature over it, and accordingly call it *Pulvinus*. Others, after *Vitruvius*, ſuppoſe it to repreſent the Curls or Treſſes of a Womans Hair.

There are alſo eight angular Volutes in the *Corinthian* Capital, accompanied with eight other ſmaller ones, called *Helices*.

There are ſeveral Diverſities in the *Volute*.

In ſome the Liſt or Edge is in the ſame Line or Plane throughout all the Circumvolutions: ſuch are the antique *Ionick* Volutes, and thoſe of *Vignola*.

In others, the Spires or Circumvolutions fall back, and in others they project or ſtand out.

Again, in ſome, the Circumvolutions are oval; in others, the Canal of one Circumvolution is detached from the Liſt of another, by a Vacuity or Aperture.

In others the Round is parallel to the *Abacus*, and ſprings out from behind the Flower of it.

In others it ſeems to ſpring out of the *Vaſe* from behind the *Ovum*, and riſes to the *Abacus*, as in moſt of the fine compoſite Capitals.

Conſoles, *Modillions*, and other

ther Sorts of Ornaments, have likewise their *Volutes*.

The *Volute* is a Part of great Importance to the Beauty of the Column. Hence Architects have invented divers Ways of delineating it.

The Principal are that of *Vitruvius*, which was long lost; and restored by *Gouldman*; and that of *Palladio*. *Daviler* prefers the former as the easier.

VOUSSOIR [in *Architecture*] a Vault-stone, or a Stone proper to form the Sweep of an Arch, being cut somewhat in manner of a truncated Cone, whose Sides, if they were prolong'd, would terminate in a Center, to which all the Stones of the Vault are directed.

VOUSSOIRS. See the Article *Bridges*. Also see the *Plate*.

The Figures 1 and 2, represent the Voussoirs of an Arch, and their Names, *viz.*

1. Is the Coussinet, or prime Voussoir, which is the first Stone of an Arch, from whence the Rise of the Center commences.

2. 2. 2, *&c.* The Voussoirs from the Head of a Bridge, and Haunses of a Vault or Arch.

3. The Key-stone, upon which, usually, are carved the Arms of him to whom the Bridge belongs, or who caused it to be erected.

A B C, the *Extrados*.

6, 8, 9, The *Extrados* and *Douelle*, *i. e.* the interior Surface of a Stone, or facing of an Arch, and Part of the Curve within one Voussoir; which in the Arch of a Bridge is sometimes also called the *Intrados.*

5, 6, The Bed of the *Douelle*.

6 and 1, The Joint of the Face or the Head.

5 and 6, The Joint of the *Douelle*.

A, 2, 8, The Height of the Retombe, which is the Position of every Stone in the Voussoir, which is laid upon the first, and is called the Coussinet of an Arch, which thence begins to form its Rise, and which being laid by themselves can subsist without a Center.

Figure 2. Represents the Empalement [*i. e.* the greatest Thickness of a Foundation of Piles] of a Foundation, from its Commencement, to which, at LH is given one fourth of the Height L M, when the Bottom L D is of a sufficient Consistence; and on the contrary, when the Bottom is doubtful, it is given one Third, or the half of L I of the Height of L M, with the Retraites.

C E proportional to the largeness of the Empalement.

The larger the Arches are of a Bridge that is projected, the larger must be the Piers and Abutments, and also the Voussoirs must be enlarg'd in Proportion.

We have indeed no certain Rule for determinig the Size of the Voussoirs of Arches, we can only take our Models from those Works which have been done, and especially of the most experienc'd antient Architects, and thence to frame a Rule for the proportioning the principal Materials, on which consists

consists almost the whole Force of Arches and their Arrangement.

I have says M. *Gautier* observ'd the Works of the *Romans*, the Extrados Voussoirs being four Feet from the Tail to the Arches, which had ten Toises in the Opening, and that the same Voussoirs had in Length in the Bed, four Foot and a half, and 15 Inches in Thickness at the hollowed or concave Part of the Inside of a Voussoir; and that the Thickness from the Arch to the Key might be five Foot.

Upon this Foot may be fram'd a Rule of Proportion for all Sorts of Semi-circular Arches; so that if one follows the Rule of the antique Arch of *Pont du Gard*; we shall find that if an Opening of ten Toises of an Arch give four Feet for the Tail of a Voussoir; that five Toises will give but two Foot; and 15 Toises, six Feet; 20 Toises, eight Feet, and in fine, 25 Toises, 10 Feet.

But I would not follow the same Proportion in Arches of five Toises below; because this would reduce the Voussoir of an Arch of one Toise, opening to six Inches in the Tail, instead of one Foot and a half, which it ought to have.

So that if we compare a Voussoir of one Foot and a half in the Tail, for an Arch of one Toise wide, with one of two Foot in the Tail for an Arch of five Toises wide, the Rule will be better followed and better proportion'd in Respect to the Force or Strength of the Materials and their Bearing.

It is certain that a large Bridge that bears a large Carriage, is less loaded than a small Bridge that bears the same Carriage. Therefore in the last the Voussoirs ought to be proportioned to the Weight of the Carriages that pass over them, and not to the Materials with which they are built, which they ought to support. and which are not very heavy.

If the Weight of Carriages were diminish'd in Proportion to the largeness of the Bridges over which they pass, the first Rule of Proportion might be observ'd; but as it is augmented in Proportion to what is done in smaller Arches, the Voussoirs ought to be made proportional to the Weight they are to support, and not to those of large Arches, where the same Weight is but one Point in Respect to their Solidity and Mass.

It is also certain that Materials of more or less Consistence, will contribute more or less to the Solidity of these Works; that Voussoirs of three Foot in the Tail that are compact and close, will render an Arch of ten Toises opening more secure, than those of four Feet, which shall be of less Consistence; by Reason of their being made of more tender or soft Stone; and from *Physicks* it is that this Knowledge is to be gained, I am of Opinion says M. *Gautier*, that if these kinds of Proportions were followed, we should not fall into those

those Errors which are every Day commiited by those who are well acquainted with this Work.

I shall give an Example of a Bridge, which Decency hinders me from naming.

The Arch fell down; it was 12 Toises in the Aperture, and the Voussoirs, altho' the Stones were very tender, had besides this, the Fault of having too little Tail to retain them; not at all proportion'd to the Rule aforesaid.

As it is only the Voussoirs that keep the Work together, and the Masonry that is ordinary above them, is laid on the Level, according to the Courses of the Facades of the Bridges, it is certain that these Courses do nothing but over-burden the Voussoirs, and that the Surplussage of Masonry, is only proper for the compleating the Breaking of the Arch, and not for the Easing it.

I was call'd to give my Advice upon the falling of this Arch, I found that the Cut of those Stones in Respect to the Scheme Arch Centre, was well perform'd, nevertheless the Work was exclaim'd against as defficient in that Point. But in the End I assur'd them, that to re-establish this Bridge, the Bounding Voussoirs ought to have a greater Length than they had made them, and that they ought to be of Stone of a stronger Consistence; and the Work being perform'd after this Manner, succeeded perfectly well.

It is certain (adds he) that *Paris* furnishes the most accomplish'd Architects in *Europe*; the Precautions that have been taken at the *Pont Royal* of the *Thuilleries*, in the Position of the Voussoirs whose Tails are without End, and which have been prolonged since the Falling of the Arches, mounting up towards the Key, as one may say to the Cordon or Plinth, and as far as to the Superficies of the Pavement, or above all, there is nothing but Voussoir *en Coupe*, according to the *Epure* of the Arches, seen at the Head for about a third Part of the Arch, all over the Place where the greatest Effort is made.

These Voussoirs *en Coupe* are lengthened at the End of their Tails, following the same Cut.

It is not because the Voussoir is intire, that it secures the Work the better; it is its Length and its bearing on the Reins of the Arch which bind it and keep it in Place; when Bridges are not extradossed, and the Cut is adjusted to perfect the whole.

A Voussoir may be easily prolonged, provided its Cut be follow'd in its prolongation, and there be no Void between them; and they may be secur'd by Cramping Irons, if you please.

My Advice, (says M. *Gautier*) is to lay them all dry, the one against the other in Courses, after the Manner of the Ancients, and not to lay them in fine Mortar, but by the Abbreuvement strained and put in.

In the fine Works of the Ancients we see that the greatest

Part of the Vaults, Arches and Arcades, and Arches built with large Blocks of hewn Stone; they neither us'd Mortar nor Cramp-Irons, and that all there was dry; they did not uſe Mortar in any but Vaults and Arches made of Shards, rough or unhewn Stones: The Mortar does not faſten and aſſure the Work but in the uniting of ſmall Materials and large Blocks of Stone, are ſuperior to the Feebleneſs of Mortar; the large Vouſſoirs of Bridges are not ſuſtain'd and ſecur'd, nor the Work, but by their own proper Weight join'd to the Cut, which prevents them from diſuniting; and this very ſame Weight, which is moſt often the Cauſe of the Ruin of the largeſt Buildings, is in Bridges the only Cauſe that ſecures them, and without which one cannot ſucceed.

It is not at all ſurprizing if the *French* Companions Stone-Cutters having penetrated beyond *Egypt*, the whole Length of the *Nile*, beyond ſome of their Cataracts and frightful Water-Falls, and having made a Stone-Bridge in one of the Places of this River, very narrow between two Rocks; they were eſteem'd as Demi-Gods.

The People of theſe Countries, very ignorant, but very docile, mock'd at the Enterprize of the *French*, but the Work being finiſh'd, they came from the Parts round about to croſs the *Nile* on this Work, not being able to comprehend that Stones thus ſet in Order, the one againſt the other, could be born up, and even as it were hang in the Air. In Reality it is the Cut of the Stones that is the Soul of all the Vaults and of all the Stone-Bridges, and ought to be look'd upon as the principal Foundation of their Conſtruction.

There are Bridges made all of Brick; they do in ſome of them, for Neatneſs, Security and Decoration, make *Arretes* and *Encoignures* of hewn Stone.

That of *Thoulouſe* may ſerve for an Example. The Bricks are laid equally in Cut to the hewn Stone, making it follow the Tract of the [Epure] Plinth or Faſcia, that has been trac'd. This they take Care on, that they be well burnt, and the Mortar good and fine, and that they may be aſſur'd of the Lime, to the End that it may ſoon lay hold.

There are alſo ſeen at *Montauban* and at ſeveral other Cities of *Languedoc*, Bridges made all of Brick, Houſes, Churches, Steeples and other magnificent Works made of Brick.

The firſt Works of the earlieſt Ages were made of Brick, the *Jews* taken Captives; after they had loſt their Liberty, were employ'd in Brick-making.

In Bridges either of Brick-work or Maſonry, the Materials ought to be expos'd to the Air and Rain for the Space of a Year; that is to ſay, one Winter and one Summer; and all at the End of that Time ought to be rejected, either Brick or Stone, that have not under-

undergone the Proof of the Heat of the Summer, and the Frost of the Winter; and the Inspectors of Works ought to cause them all to pass in Review the one after the other; and immediately break off the the Corners of all those that are not Proof.

Too great Precautions can't be taken in Works of such Consequence, which very often can't be remedied when once done.

The greatest Works of the first Men were built with nothing but Brick: the Tower of *Babel* and the Walls of *Babylon* were built only with Brick; and the Bricks are found as sound as they were the first Day they were laid there: For Mortar they us'd nothing but *Spaltum*, a Sort of Bitumen which they brought from a neighbouring Lake, and as some say, they mix'd Straw with it between the Joints of the Bricks to make a binding, which yet is seen intire, if with a Hammer a Piece of Brick is broken off with the Cement, if we believe what those who have travelled to those Parts have related.

When the Arches of one and the same Bridge have been larger the one than the other, and yet the Keys of the same Height; they have not brought them upon a Level, but in establishing the first Rises of the biggest Arches in the Piers below those of the smallest in Proportion to their Size.

They always also made their Arches Semi-circular, and rather than to sink them by Ellipsises, they rather chose to use one Portion of a great Arc, as has been observ'd of the *Pont du Gard*.

The *Goths* who succeeded to the good Gust of the *Roman* Architecture, made Bridges in many Parts of *France*, with *Gothic* Arches, *i.e.* of the *Third Point*, as certainly pretending by that to make less Push; both in their publick Buildings and Bridges, we see in many Places, and also in private ones; and also in those Churches which we see that were built in their Time. These *Gothic* Arches rise most in Bridges.

The Moderns on the Contrary by a Change and Novelty, common to all Ages, have fallen into Elliptical Arches; in Order to diminish the Ramp of Bridges, and by that Means to facilitate the Ascent of heavy laden Carriages.

One time or other, Change in these Things will come, when they will put on another Mode, according to the Humour of those Times.

Men begin to admire Scheme Arches, and yet Plat-Bands more; in fine, all that is the most compos'd where Nature is the most forc'd, or in which there is the most Labour, or the Art of which is the most surprizing, is what is at this time most in Fashion.

Of these three Manners of Arches, it may be said that that which is of the *Third Point* or *Gothic*, is capable of bearing a greater Load than a Semi-circular Arch; and a Semi-

Semi-circular than a Scheme Arch or an Elliptical one; the first is the most elevated or highest; the second is lower, and the last is the most Rampant and lowest.

Both the one and the other augment or diminish their Pushes in Proportion to their Disposition, and of Consequence they are differently us'd.

I have given upon the one and the other a Differtation, which proves and demonstrates their Efforts more or less, to determine the Thickness of the Abutments which must sustain or keep them in, and the Piers which are to support them.

Thus far M. *Gautier*. See the Article *Bridges*.

UPRIGHT [in *Architecture*] is a Representation or Draught of the Front of a Building, call'd also an *Elevation*.

URN [in *Architecture*] a kind of Vase of a roundish Form, but biggest in the middle like the common Pitchers; now seldom us'd but as Ornaments, over Chimney-Pieces, Buffets, *&c.* or by way of Acroter's, a Top of Buildings, Funeral Monuments, *&c.* or

Serving as a Crowning over Ballustrades, and as an Attribute to Rivers, River-Gods, *&c.* in the Grotto's and Fountains in Gardens.

A Funeral Urn is a kind of cover'd Vase, enrich'd with Sculpture, and serving as the Crowning or finishing of a Tomb, a Column, a Pyramid, or other Funeral Monument, made in Imitation of the Ancients, who deposited the Ashes of their deceas'd Friends in this kind of Urn.

W.

WAINSCOT [in *Joinery*] is the Timber Work that serves to line the Walls of a Room, being usually in Pannels, and painted to serve instead of Hangings.

Even in Halls, 'tis usual to have Wainscot Breast high, by Reason of the natural Humidity of Walls.

Some Joiners put Charcoal behind the Pannels of the *Wainscot*, to prevent the sweating of the Stone and Brick-walls from unglucing the Joints of the Pannels; others use Wool for the same Purpose; but neither the one nor the other is sufficient in some Houses: the only sure way is to prime over the Back-Sides of the Joints with *White-Lead*, *Spanish-Brown* and *Linseed-Oil*.

The Price of Wainscotting is various. The Wainscotting with *Norway Oak*, the Workmen finding Stuff, is valued at 6 *s.* or 7 *s. per* Yard Square: The Workmanship only is about 2 *s.* in *London*: in *Rutland* 3 *s.* 6 *d.* or 4 *s. per* Yard, and Mr. *Wing* says five, if the Mouldings be large.

Plain Square Wainscotting] The Workman finding *Deal*, is valued at 3 *s.* and 3 *s.* 6 *d. per* Yard. For Workmanship only 1 *s. per* Yard.

Ordinary Bisection Wainscotting (the Workman finding *Deal*) is worth in *London* 3 *s.* 6 *d. per* Yard;

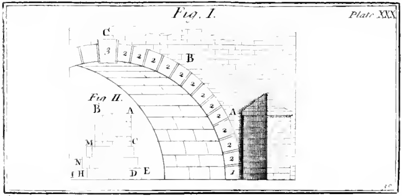


Fig. I.
Plate XXX
C
3
2
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Fig. II.
B
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1

Yard: in the Country 4 *s.* and 4 *s.* 6 *d.* The Workmanſhip only 1 *s.* and 1 *s.* 6 *d. per* Yard.

Large Biſection *Wainſcotting*, with *Dantzick* Stuff is valued at ſix or ſeven Shillings *per* Yard.

Of *Meaſuring Wainſcotting.* Wainſcot is generally meaſured by the Yard ſquare, *i. e.* nine ſuperficial Feet. Their Cuſtom is to take the Dimenſions with a String, preſſing it into the Mouldings; for they ſay, (and it is reaſonable to be believ'd) we ought to be paid for all where the Plane goes. Therefore when Joiners would take the Dimenſions of a Room, they tack up a Line on the Top of the Corner of the Room, and as they carry it down to the Bottom, they preſs it with their Fingers into all the Mouldings; this they account the Breadth, and they meaſure the Circumference of the Room from the Length.

Some Joiners will meaſure this alſo with a String, but others do not.

The Dimenſions being thus taken in the Feet, they multiply the Length by the Breadth, and the Product is the Content in Feet, which being divided by 9, the Quotient is the Content in Yards.

But you are to note, 1ſt, That Deductions are to be made for all Window-Lights, and that the Window-Boards, Cheeks and Soffeta's are to be meaſured by themſelves.

2. That they reckon work and a half for *Window-ſhutters*, *Doors*, and ſuch Things as are wrought one both Sides; and indeed the Work is Half more.

3. That ſometimes *Cornices*, *Baſes* and *Sub-baſes* are meaſured by the Foot lineal Meaſure; and ſo likewiſe are *Freezes*, *Architraves*, and *Chimney-pieces* meaſured, unleſs agreed for by the great.

WALLS [in *Architecture*, &c.] a Work of *Brick*, *Stone*, *Wood*, or the like, which make the principal Part of a Building, as ſerving both to encloſe it, or ſeparate particular Rooms, and to ſupport the Roof, Floors, *&c.*

Walls are either intire or continual, or intermitted, and the Intermiſſions are either Pillars, or Pillaſters.

Walls tho' built very thick and ſtrong, and their Foundations laid deep, yet if carried on in a ſtrait Line, are inclin'd to lean or fall; and ſuch as are built crooked, tho' thin and weak, are much more laſting.

A *Wall* raiſed over a River on Arches of Pillars, will ſtand as firm as others whoſe Foundation is entire.

Hence it appears, that a Wall built much thinner than uſual, by only having at every 20 Foot's Diſtance, an Angle, ſet out at about two Foot or more in Proportion to the Height of the Wall; or by having a Column at the like Diſtance erected along with it, ſix or eight Inches on each Side, and above the Thickneſs of the reſt of the Wall: Such a Wall will be much ſtronger than if five Times the Quantity of Mate-

rials were uſed in a great Wall.

Walls are diſtinguiſhed into divers kinds from the Matter of which they conſiſt. As,

Plaiſtered or *Mud-Walls*, *Brick-Walls*, *Stone-Walls*, *Flint* or *Boulder-Walls*, and *Boarded-Walls*. In all which theſe general Rules are to be regarded.

1. That they be built exactly perpendicular to the Ground-work; for the right Angle therein depending, is the true Cauſe of all *Stability*, both in artificial and natural Poſition; a Man likewiſe ſtanding firmeſt when he ſtands the moſt upright.

2. That the maſſieſt and heavieſt Materials be the loweſt, as fitter to bear, than to be born.

3. That the Walls as they riſe, diminiſh proportionably in Thickneſs, for Eaſe both of Weight and Expences.

4. That certain Burſes or Ledges, of more Strength than the reſt, be interlaid like Bones, to ſtrengthen the whole Fabrick.

Plaiſtered or *Mud-Walls*. Theſe kind of Walls are common in Timber Buildings, eſpecially ordinary Buildings; for ſometimes the Walls are made of Brick between the Timber. But this Way is not approved of, becauſe the Mortar corrodes and decays the Timber. Theſe Mud-walls (as they are called in ſome Places) are thus made.

The Walls being quartered, and lath'd between the Timber (or ſometimes lathed over all) are plaiſtered with Lime, which being almoſt dry, is plaiſtered over again with white Mortar.

This Sort of Work is commonly done by the Yard. For the Price of it, ſee *Pargetting* and *Plaiſtering*.

Brick-Walls, which are the moſt important and uſual among us; therefore to the four Rules before mentioned, theſe are to be added.

1. Particular Care is to be taken about laying of the Bricks, *viz.* that in Summer they be laid as wet, and in Winter as dry as poſſible, to make them bind the better with the Mortar: That in Summer, as faſt as they are laid they be covered up, to prevent the Mortar, &c. from drying too faſt; that in Winter they be covered well to protect them from Rain, Snow and Froſt, which are all Enemies to Mortar; that they be laid point and joint in the Walls as little as may be, but that good Bond be made there as well as on the Outſide.

2. That the Angles be firmly bound, which are the Nerves of the whole Edifice, and therefore are commonly fortified by the *Italians*, even in their Brick Buildings, on each Side of the Corners, with well ſquared Stone, yielding both Strength and Grace.

3. In order to which, in working up the Walls of a Building it is not adviſeable to raiſe any Wall above eight Foot high, before the next adjoining Wall be wrought up to it, that ſo

good

good Bond may be made in the Progreſs of the Work: For it is an ill Cuſtom among ſome Bricklayers, to carry or work up a whole Story of the Party Walls before they work up the Fronts, or other Work adjoining, that ſhould be bonded, or wrought up together with them; which occaſions Cracks and Settlings in the Walls.

4. That if you build a Houſe in the City of *London*, you make all your Walls of ſuch Thickneſſes as the Act of Parliament for re-building the ſaid City enjoins; which Act you may ſee in the Article *Houſe*; but in other Places you may uſe your Diſcretion. Yet for ſome Directions in this Matter, turn to the Article *Houſe*.

5. It may be worth your Notice, that a Wall a Brick and half thick, with the Joint, will be in Thickneſs 14 Inches, or very near; whence 150 or 160 Bricks will lay a Yard ſquare, meaſured upon the Face of the Building, and to the Square of 10 Foot (which is 100 Foot ſquare Feet) are uſually allowed 1700 or 1800 Bricks, and 4600 or 5000 Bricks will compleatly lay, erect or build, one Rod, Pole or Perch ſquare; which Rod, Pole or Perch; (for by all theſe Names it is called) contains in Length (according to the Statute 16 ½ Feet, whoſe Square is 272 ¼ Feet, ſuperficial Meaſure, which is 30 Yards and ¼.

But tho' I have given the Number of Bricks for each of theſe Squares; yet theſe Numbers are not to be relied on as abſolutely exact; for no Exactneſs can be diſcovered as to this Particular, and that for ſeveral Reaſons.

For notwithſtanding that all the Bricks be made in the ſame Mould, and burnt in the ſame Kiln or Clamp; yet the Nature or Quality of the Earth of which they are made (which cauſes ſome to ſhrink more than others) and the Bricklayers Hand and Mortar, may cauſe a conſiderable Variation.

And beſides theſe, ſome Bricks are warp'd in Burning, (which makes them that they will not lie ſo cloſe in the Work) ſome are broken in the Carriage; ſo that 500 Bricks and the Tally or Tale is, for the moſt Part (if not look'd after) too little.

And beſides all theſe Uncertainties, when Bricks are dear, and Lime cheap, the Workman by the great, will uſe more Mortar, and make the larger Joints, which is much worſe for the Building.

6. It may be alſo noted, that (when all Materials are ready) a Workman with his Labourer, will lay, in one Day, 1000 Bricks, and ſome 12 or 1500.

7. All Brick Work, according to theſe Rules, is ſuppoſed to be one Brick and half thick, which is the Standard Thickneſs. If they are thicker or thinner, they muſt be reduced to that Thickneſs.

Of Meaſuring Brick Walls.

Bricklayers moſt commonly meaſure their Walls by the Rod

 ſquare,

ſquare, each Rod (which is by the Statute $16\frac{1}{2}$ Foot;) ſo that a Square contains $272\frac{1}{4}$ ſuperficial Feet.

Therefore when they have taken the Dimenſions (*viz.* the Length and Height) of the Wall in Feet, they multiply the Length by the Height, by croſs Multiplication, and divide the Product by $272\frac{1}{4}$, and the Quotient ſhews the Number of ſquare Rods in the Superficies of that Wall.

But it being troubleſome to divide by $272\frac{1}{4}$, Workmen have a Cuſtom to divide by 272 only, which gives the Contents ſomething more than the Truth, which notwithſtanding they take for it.

When they have then found the Area, or Contents of the whole Superficies of a Wall, they in the next Place conſider its Thickneſs; for they have a certain Thickneſs to which they reduce all their Walls, and this Standard is *one Brick and a half thick*, as they phraſe it, (*i. e.* the Length of one Brick, and the Breadth of another; ſo that a Wall of three Bricks (Length) thick, of the ſame Height and Length with another of one and a half Brick thick, the former will contain twice as many ſquare Rods as the latter.

Now to reduce any Wall to this Standard Thickneſs, take this Rule, which is plain and eaſy.

Say, as three is to the Thickneſs of the Wall in half Bricks, that is in the Breadth of the Bricks, the Breadth of a Brick being always half its Length, ſo is the Area before found to the Area at their Standard Thickneſs of $1\frac{1}{2}$ Brick.

Thus if a Wall be all of one Thickneſs from the Foundation to the Top, it is eaſily reduced to the Standard Thickneſs of $1\frac{1}{2}$ Brick.

But if the Wall be of different Thickneſſes (as they uſually are in Brick Houſes, being made thickeſt below, and thinner at every Story) then the beſt Way will be to meaſure every different Thickneſs by it ſelf, and to reduce it to the Standard Thickneſs, and afterwards add all theſe ſeveral Areas into one Sum, out of which deduct the Doors and Windows (meaſured by themſelves) and then the Remainder will be the true Area or Content of the whole Walling.

Note, That in ſome Places 'tis the Cuſtom to meaſure by the Rod of 18 Feet long, and in others by the Rod of 16 Feet. In the former Caſe, the Area in Feet muſt be divided by 324, and in the latter by 356.

As to the Price.] The Price of building Walls is various in different Places, according to the various Prices of Materials.

Mr. *Leybourn* ſays, that the uſual Price in *London* for building a Brick and a half Wall, the Workman finding all Materials, is 5 *l.* or 5 *l.* 10 *s. per* Rod ſquare, and for the Workmanſhip only 30 *s. per* Rod ſquare, which is about 1 *s. per* Yard ſquare.

Mr. *Wing* ſays, That the uſual Price in *Rutland*, (the Work-

Workman finding all Materials) is for a Brick and a half, 3 *s. per* Yard ſquare, (which is but about 4 *l.* 10 *s. per* Rod) for a two Brick Wall 4 *s.* and for a two and a half Brick Wall 5 *s. per* Yard ſquare.

And for the Workmanſhip only (of a Brick and a half Wall) 8 *d. per* Yard ſquare, which is but about 20 *s. per* Rod, Statute Meaſure.

In *Suſſex* a Rod of Brick and half Walls, Workmanſhip and Materials, will coſt at leaſt 8 *l.* For the Workmanſhip only, the uſual Price is 24 or 25 *s. per* Rod ſquare, in a Brick and half Wall.

Mr. *Leybourn* ſays, That in or about *London*, if the Bricks are laid in at the Builder's Charge, then 2 *l.* 10 *s. per* Rod, is the uſual Price.

But he ſays likewiſe, for erecting new Structures, by taking down old Walls, it may be worth 3 *l.* or 3 *l.* 10 *s. per* Rod; becauſe in taking down the Walls, there is much Time ſpent. And alſo more Mortar uſed in laying them again, than in the new Work.

Fence Walls are Walls built round Courts, Gardens and Orchards, *&c.* which are commonly called *Fence Walls*; of which ſome are made of Stone, ſome of Flints, or Boulders, and ſome of Brick.

1. *As to thoſe made with Brick.*] Theſe are commonly made (of Statute Bricks) a Brick and a half thick.

In ſome Parts of *Suſſex* they are made of a Sort of great Bricks, which are 12 Inches long, 6 Inches broad, and 3 Inches thick.

Theſe Walls are but the Breadth of a Brick, or ſix Inches in Thickneſs, only at the Pilaſters, where they are the Length of a Brick, or 12 Inches.

They uſually ſet a Pilaſter at every 10 Foot. Some of theſe Walls have ſtood well for 30 Years, and were in good Condition.

Of the meaſuring of them.] Fence Walls built of Statute Bricks, are commonly meaſured as the other.

But ſome meaſure them by the Rod in Length, and one Foot in Height, which they account a Rod in Meaſure; and in taking the Dimenſions, they do it with a Line going over the Pilaſters: this for the Length. So alſo for the Height, they meaſure that by the Line going over all the Mouldings (after the ſame Manner that Joyners meaſure their Work) even to the Top or Middle of the Copeing.

Some Workmen in making Fence Walls of Statute Bricks (if they can perſuade their Maſters to agree to it) meaſure all that is above a Brick and half thick (*viz.* the projecting of the Pilaſters or Battreſſes, and all below the Water-Table, by the ſolid Foot, which they afterwards reduce to Rods.

This Way is a conſiderable Advantage to the Workman, and a Loſs to the Maſter-Builder; for it makes one ſixth Part more of Meaſure than the Truth; becauſe a Brick and half Wall is 14 Inches thick.

Fence Walls of great Bricks are generally measured by the Rod in Length, and a Foot in Height, which they account a Rod in Measure, the Dimensions being taken by a Line, as has been said above.

Of the Price.] Some Workmen in *Sussex* reckon for building Fence Walls (for Workmanship only) of Statute Bricks, a Brick and half thick, 1 *s.* 6 *d.* *per* Rod, at a Rod long, and a Foot high, taking their Dimensions by the Line, according as has been shewn.

Sometimes they build these Walls by the Square of 100 Foot at 8 *s. per* Square, which is but about 1 *d. per* superficial Foot.

For building Fence Walls with great Bricks, the common Price (for Workmanship only) is 1 *s. per* Rod, at one Rod long, and one Foot high, the Dimensions being taken by the Line, as above.

Of Copeing them.] Fence Walls, built with Statute Bricks, are sometimes cop'd with Stone, sometimes with Brick. If they are cop'd with Stone, the Copeing is left out of the Measure, and rated by itself; for the Price of which, see *Copeing*. If they are coped with Brick, it is measured into the rest of the Work.

And this Sort of Copeing is performed as follows. The Wall is carried up to the Top on one Side, and on the other Side there is two Courses of Bricks, standing on end, in an oblique reclining or slant Position, and a stretching Course on the Top finishes the Wall.

But Fence Walls built of great Bricks are coped with copeing Bricks; of which, see *Bricks*. And this Copeing is also measured and rated with the rest of the Wall.

Of Stone Walls.

Stone Walls serve not only for Walls of Houses, &c. but also for Fence Walls round Gardens, &c.

Of measuring them.] These are in some Places measured by the Rod of 18 Foot Square; but in most Places they are measured by the superficial Foot.

There are three Things to be observed in measuring of them.

1. That if the Length of the Walls at the Ends of the Garden or House, be taken on the Outside of the Garden or House, then the Length of the Walls on the Sides of the Garden or House, ought to be taken on the Inside.

2. That when the Walls of a House are measured, the Doors and Windows are likewise to be measured and deducted from the whole.

3. That in measureing Fence Walls, they commonly measure the Height by a Line (pressed into all the Moulding) from the Top of the Copeing to the Bottom of the Foundation.

As to their Price.] Mr. *Wing* says, That Fence Walls of ordinary Buildings, are each (only the Workmanship) from

16 *s.*

16 *s.* to 3 *l.* 10 *s. per* Rod, of 18 Feet ſquare, which, he ſays, depends upon the Goodneſs of the Work.

He alſo ſays, that ſetting Fronts in great Buildings, *viz. Aſhlar*, *Architrave*, *Windows* and *Doors*, with Ground-table *Faſcias*, and other Members, is worth from 3 *l.* 10 *s.* to 5 *l. per* Rod, which, he ſays, depends upon the Height and well performing the Building.

But what he ſays, is not very intelligible; for 3 *l.* 10 *s. per* Rod, is but a little above 2 *d.* ½ *per* Foot; and 5 *l. per* Rod, but little more than 3 *d.* ½ *per* Foot; either of which is certainly too little for ſuch ornamental Work, as ſetting off of Fronts in great Buildings. Neither does he mention any Thing of the Thickneſs of the Walls.

And then as for Fence-walls, or Walls in ordinary Buildings, it does not appear how the Goodneſs or Badneſs of ſuch plain Work, can vary the Price from 15 *s.* to 3 *l.* 10 *s. per* Rod.

Mr. *Hatton* talks much after the ſame Manner, when he ſays, that one Foot of plain Work (as Walls, *&c.*) is worth about 8 *d.* working and ſetting. Nor does he mention any Thing of the thickneſs.

But theſe Authors having left us in the dark, I ſhall leave them, and inform you what is more intelligible, and what a *Suſſex* experienc'd Workman ſays of the Matter: That for Building a 12 Inch Wall they have 2 *d. per* Foot; for an 18 Inch Wall, 3 *d.* that for a Wall of two Foot thick, they have 4 *d. per* Foot.

Theſe Prices are to be underſtood of Walls which have two fair Sides; for if they have but one fair Side (the other ſtanding againſt a Bank) they have a leſs Price. And in this Caſe ſome Workmen have built a Wall for 2 *d.* ½ *per* Foot.

Flint or Boulder Walls.

Theſe Walls are much uſed in ſome Parts of *Suſſex* and *Kent*, both for Fence Walls, round Courts, Gardens, *&c.* but alſo Walls of Stables and other Out-houſes, which have looked very handſome.

To build Walls and greater Works of Flint, of which we do not want Examples in our Iſland, and particularly in the Province of *Kent*, (ſays Sir *Henry Wotton*) is, I conceive, ſays he, a Thing utterly unknown to the *Ancients*, who, obſerving in that Material a kind of metallick Nature, or at leaſt a Fuſibility, ſeem to have reſolved it into a nobler Uſe; an Art now utterly loſt, or perchance kept up but by a few Chymiſts.

Some Workmen ſay, that for building Flint or Boulder Walls, they uſe to have 12 *s. per* hundred (for ſo they phraſe it) by which they mean 100 ſuperficial Feet.

A Right and Left-hand Man fit well together for this Work, for they have a Hod of Mortar pour'd down upon the Work, which they part between them, each ſpreading it towards him-

ſelf, and ſo they lay in their Flints.

Their Mortar for this Work muſt be very ſtiff, and it is beſt to have a good Length of Work before them; becauſe they work but one Courſe in Height at a Time; for if they ſhould do more, it would be apt to ſwell out at the Sides, and run down.

They alſo ſay it is very difficult to make the Work ſtand in miſty Weather.

Boarded Walls.

Walls are ſometimes boarded, particularly the Walls of ſome Barns, Stables and other Out-houſes. But of this Kind of Work, ſee *Weather-Boarding*.

WALLS [for *Gardens*, &c.] The Poſition, Matter and Form of *Walls* for Fruit-trees, have great Influence on them for ripening the Fruit; tho' Authors differ as to the Matter and Form of them, which ought to have the Preference.

The Reverend Mr. *Laurence* directs, that the Walls of a Garden be not built directly to face the four Cardinal Points; but rather between them, *viz.* South-eaſt, South-weſt, North-eaſt and North-weſt; in which the two former will be good enough for the beſt Fruit, and the two latter for Plumbs, Cherries, and baking Pears.

Mr. *Langford*, and ſome others propoſe, that Garden Walls ſhould conſiſt chiefly of Semi-circles, each about ſix or eight Yards in Front, and including two Trees; and between every two Semi-circles, a Space of two Foot of *Plain-wall*.

By ſuch a Poſition, he ſays, every Part of a Wall will enjoy a Share of the Sun one Time with another; beſides, that the Warmth will be increas'd, by the collecting and reflecting of the Rays in the Semi-circles, and the Trees within will be alſo ſcreened from injurious Winds.

Mr. *Fatio* propoſes to have *Garden-walls* built ſloping, inſtead of perpendicular, or reclining from the Sun; that what is planted againſt them may lie more expoſed to his perpendicular Rays; which muſt very much contribute to the ripening of Fruit in our cold Climate.

He directs, That the Angle of Reclenation be that of the Latitude of the Place; that when the Sun is in the Meridian at the Equinoxes, his Rays may ſtrike perpendicularly; yet others prefer *perpendicular Walls*, and even inclining ones, or ſuch as hang forwards to the Sun; becauſe ſuch will receive the Sun's Rays, perpendicularly, when ſhe is low, as in *Spring* and *Autumn*, or in the Evening and Morning; which they imagine to be more ſerviceable than the greateſt Heats of the Sun at *Mid-ſummer* upon *Reclining Walls*.

To this may be added, that in *Autumn* the Sun is moſt wanted to ripen *Winter* Pears, in order to which they ſhould be kept dry, which cannot be done

done againſt ſloping Walls; the Dews, &c. lying much longer on them, than on ſuch as are perpendicular.

However Mr. *Fatio*'s ſloping Walls have one great Advantage, *viz.* that Fruit-trees, as Vines, &c. being planted againſt them, cloſe Glaſſes may be ſet on the Fruit, which will very much forward its Ripening.

As for the Materials of Walls for Fruit-trees, Mr. *Switzer* approves of Brick as the beſt, as being the warmeſt and kindeſt for the ripening of Fruits, &c. affording the beſt Conveniency for uniting,

But Mr. *Laurence* affirms on his own Experience, that Mud Walls, made of Earth and Straw, tempered together, are better for the Ripening of Fruit, than either *Brick* or *Stone-Wall*: and he adds, that a Copeing of Straw laid on ſuch *Walls*, is a great Advantage to the Fruit, in ſheltering them from perpendicular Rains, &c.

WALLING. Bricklayers commonly meaſure their Work by the Rod ſquare, 16 Feet and a half; ſo that one Rod in Length, and one in Breadth, contain 272.25 ſquare Feet; for 16.5 multiplied in it ſelf, produce 272.25 ſquare Feet.

But it is the Cuſtom in ſome Places to allow 18 Feet to the Rod; which is 324 ſquare Feet.

In ſome Places again, the Cuſtom is to meaſure by the Rod of 21 Feet long, and three Feet high; which makes 63 ſquare Feet; and in this Caſe they never regard the Thickneſs of the Wall; but the Cuſtom is to make the Price according to the Thickneſs.

When you are to meaſure a Piece of Brick-work, you muſt firſt conſider which of the foreſaid ways it is to be done by, and then multiply the Length and Breadth in Feet together, and divide the Product by the proper Diviſor, either for Rods or Roods, and the Quotient will be ſquare Rods, or ſquare Roods accordingly.

But uſually Brick Walls which are meaſured by the Rod, are to be reduced to a Standard Thickneſs, *viz.* of a Brick and a half thick (if there has been no Agreement made on the contrary. And to reduce a Wall to a Standard Thickneſs, the following is

The RULE.

Multiply the Number of ſuperficial Feet contained in the Wall, by the Number of half Bricks that Wall is in Thickneſs; and one Third of the Product will be the Contents in Feet, reduced to the Standard Thickneſs of a Brick and a half.

Example

Example 1. Suppose a Wall to be 72 Feet 6 Inches long, and 19 Feet 3 Inches high, and 5 Bricks and a half thick, how many Rods of Brick Work are contained in that Wall when reduced to the Standard?

```
                 19.25
                 72. 5
               ---------
                  9625
                 3850
               13475
             -----------
               1395.625
                     11
             -----------
           3)15351.875
          -------------
272.25)  5117.291( 18 Rods.
         ----------
         239479
         ----------
   68.06) 21679 ( 3 Quarters of a Rod.
           12.61
         ----------
```

Answer, 18 Rods 3 Quarters 12 Feet.

```
            F.      I.
            72      6
            19      3
          -------------
           648
           72
             18 : 1 : 6
              9 : 6 : 0
          -------------
          1395 : 7 : 6
            11
         ---------
      3) 15345
         ---------
   272) 5115 ( 18 Rods.
         2395
         ---------
    68.) 219 ( 3 Quarters of a Rod.
          15
```

Note,

Note, That that 68.06 is one fourth Part of 272.25.

Note alſo, That in reducing of Feet into Rods, they uſually reject the odd Parts, and divide only by 72, as is done in the ſecond Way of the laſt Example; ſo the Anſwer by that ſecond Way is 18 Rods, 3 quarters, and 15 Feet, more by about 2 Feet and a half, than by the firſt Way, in which it is done decimally; but this Surplus is but very inſignificant.

Example 2. If a Wall be 245 Feet 9 Inches long, and 16 Feet 6 Inches high; How many Rods of Brick Work are contained in it, when reduced to a Standard Thickneſs?

```
           245.75
             16.5
          ---------
           122875
          147450
          24575
          ---------
          4054.875
                5
       ------------
     3) 20270
  272)  6756 ( 24 Rods.
       -------
        1316
       -------
           24 ( 3 Quarters of a Rod.
```

Anſwer, 24 Rods, 3 Quarters, 24 Feet.

```
    F.      I.
   245      9
    16      6
  -------------
  1470
  245
   122  :  10  :  6
    12  :  00  :  0
  -------------------
  4054  :  10  :  6   The Anſ. in Feet.
```

I ſhall in the next Place ſhew how to find proper Diviſors to facilitate the Operation, becauſe it would be too intricate and tedious to perform by Scale and Compaſſes.

To find proper Divisors.

Divide 3, (the Number of half Bricks in $1\frac{1}{2}$) by the Number of half Bricks in the Thickneſs, the Quotient will be a Diviſor, which will give the Anſwer in Feet.

But if you would have a Diviſor, to give the Anſwer in Rods at once, then multiply 272.25 by the Diviſor found for Feet, and the Product will be a Diviſor, which will give the Anſwer in Rods.

Example, To find a proper Diviſor to reduce a Wall of 3 Bricks thick.

Divide 3 by 6 (the half Bricks in the Thickneſs) and the Quotient will be .5, which is a Diviſor that will give you the Anſwer in Feet.

Then multiply 272.25 by .5 and the Product will be 136.125, which is the Diviſor that will give the Anſwer in Rods; that is as 136.125 is to the Length of the Wall, ſo is the Height to the Content in Rods; or as .5 is to the Length, ſo is the Height to the Content in Feet.

After the ſame Manner you may find Diviſors for any other Thickneſs, which you will find to be, as expreſs'd in the following Table.

The Thickneſs of the Wall.	Diviſors for the Anſwer in Feet.	Diviſors for bringing the Anſwer in Rods.
1 Brick thick	1.5	408.375
$1\frac{1}{2}$ Brick thick	1	272.25
2 Bricks thick	.75	204.1875
$2\frac{1}{2}$ Bricks thick	.6	163.35
3 Bricks thick	.5	136.125
$3\frac{1}{2}$ Bricks thick	.4285	116.678
4 Bricks thick	. 375	102.0937

Let the ſecond Example preceeding (where the Length is 245.75, the Height 16.5, and the Thickneſs $2\frac{1}{2}$ Bricks) be wrought by Scale and Compaſſes. Thus,

Extend the Compaſſes from 163.35 (the Tabular Number againſt $2\frac{1}{2}$ Bricks) to 245.75, and that Extent will reach from 75.5 to 12.13; that is 12 Rods and a little above half a Quarter.

Again,

Again, if the Length be 75 Feet 6 Inches, and the Height 18 Feet 9 Inches, at $3\frac{1}{2}$ Bricks thick, how many Rods are contained therein?

Extend the Compasses from 116.678 (the Tabular Number) to 18.75. that Extent will reach from 75.5, to 12.13; that is 12 Rod, and a little above half a Quarter.

It will be very proper and convenient, for such as frequently measure Brick Work, to have in the Line of Numbers, little Brass Centre Pins, at each of the Numbers in the third Column of the foregoing Table, with a Figure to denote the Thickness of the Wall.

If a Wall be 104 Feet 9 Inches long, and 17 Feet 3 Inches high; How many Rods does it contain?

```
       104.75
        17.25
     ---------
        52375
       20950
      73325
     10475
   -----------
63 ) 1806.9375 ( 28
     126
    -----
      546
      504
    -----
       42
```

Answer, 28 Rods, 42 Feet.

```
   F.        I.
   104       9
    17       3
   --------------
   728
  104
    26  :  02  :  3
    12  :  09  :  0
  ------------------
  1806  :  11  :  3
```

Note,

Note, That those who dig Cellars, do many Times do them by the Floor, 16 Feet Square, and a Foot deep being a Floor of Earth; that is 324 solid Feet.

WASHING [in *Painting*] is when a Design drawn with a Pen or Crayon, has some one Colour laid over it with a Pencil, as *Indian* Ink, Bistre or the like, to make it appear the more natural, by adding the Shadow of Prominences, Apertures, &c. and by imitating the particular Matters, whereof the Thing is suppos'd to consist.

Thus they wash with a pale Red to imitate Brick and Tile; with a pale *Indian* Blue, to imitate Water and Slate; with Green, for Trees and Meadows; with Saffron or *French* Berries, for Gold or Brass; and with several Colours for Marbles.

These Washes are usually given in equal Teints or Degrees throughout; which are afterwards brought down and softened over the Lights with fair Water, and strengthened with deeper Colours for the Shadows.

WASHING *of Colours*. Some Colours are of such a gritty, sandy Nature, that it is impossible to grind them so fine as some curious Works require; therefore in order to get forth the Flower and Fineness of the Colour, you must do thus;

Take what Quantity of Colour you please to wash, and put it into a Vessel of fair Water, stir it about till the Water be all colour'd therewith, and if any Filth swim on the Top of the Water, scum it clean off, and when you think the grossest of the Colour is settled at the Bottom, then pour off that Water into another earthen Vessel, that is large enough to contain the first Vessel full of Water four or five Times; then pour more Water into the first Vessel, and stir the Colour that remains till the Water be thick; and after it is a little settled, pour that Water also into the second Vessel, and fill the first Vessel again with Water, stirring it as before; do this so often, as till you find all the finest of the Colour drawn forth, and that none but coarse gritty Stuff remains in the Bottom; then let this Water in the second Vessel stand to settle till it is perfectly clear, and that all the Colour be sunk to the Bottom; which when you perceive, then pour the Water clear from it, and reserve the Colour in the Bottom for Use, which must be perfectly dry'd before you mix it with Oil to work.

The Colours thus ordered, are *Red Lead*, *Blue* and *Green Bice*, *Verditer*, *Blue* and *Green Smalt*, and many times *Spanish Brown*, when you would cleanse it well from Stones for some fine Work, as also *Yellow Oker*, when you intend to make *Gold Size* of it.

WATER *Colours* [in *Painting*] are such Colours as are only diluted and mix'd up with Gum Water, in Contradistinction to *Oil Colours*.

Water Colours are us'd in what

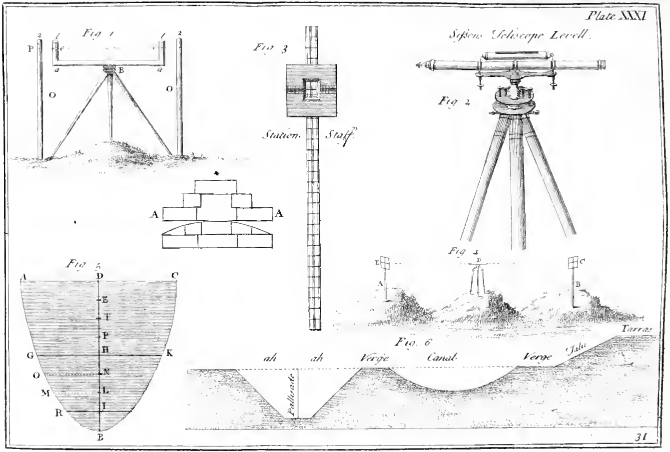
Plate XXXI
Fig 1
Fig 3
Station Staff
Sisson Telescope Levell.
Fig 2
Fig 4
Fig 5
Fig. 6
ah
ah
Verge
Canal
Verge
Talu
Tarras
Palissade
31

what we call *Limning*; as *Oil Colours* are in Painting, properly so call'd.

WATER TABLE [in *Architecture*] is a Sort of Lodge left in Stone or Brick Walls, about 18 or 20 Inches from the Ground (more or less) from which Place the Thickness of the Wall is abated (or taken in) the Thickness of a Brick.

In Brick Walls two Inches and a ¼; thereby leaving that Ledge or Jutty that is call'd a Water Table.

These *Water Tables* are sometimes left plain, and sometimes they are wrought with Mouldings; if the latter (besides the plain Measure of the Wall) they are rated at so much *per* Foot, running Measure.

WATER COURSES. These are commonly rated by the Foot running Measure. If the Workman find Materials, about 10 *d. per* Foot; if he find no Materials, about 8 *d.*

As to the Conveyance of Water from the Tops of Houses and Balconies,

It is enacted by an Act of Parliament made in the XI. Year of King *George* I. that the Water falling from the Tops of Houses, after the 24th of *June* 1725 within the Cities of *London* and *Westminster*, or their Liberties, from their Balconies, Pent-Houses, &c. shall be convey'd into the Channels by Party Pipes, fix'd on the Sides or Fronts of the said Houses; on the Forfeiture of ten Pounds for every Offence.

WATER being an Element so absolutely necessary to all Manner of Habitations, and being not always to be found near enough to them for Use; it will not be improper to consider by what Means it may be found, and how it may be conducted.

The learned VARENNIUS in his System of *General Geography*, tells us from *Vitruvius*, that if Fountains do not flow of their own Accord, their Heads are to be sought for under Ground, and so collected together. Which Springs may be discovered in the following Manner: If you lie down on the Ground, in Places where you would seek for them, before the Sun rises, and having plac'd your Chin as close as you can, till it is, as it were, prop'd by the Earth, so that the adjacent Country may be plainly seen; (the Reason of this Posture is, that by this Position the Sight will not wander any higher than it ought): if you keep your Chin unmov'd, it will give a certain Definition and true Level of the Parts where you are plac'd, and in those Places where you see Vapours gathering themselves together and rising up into the Air, there you may dig; for this Sign never happens in a dry Place.

2. *Coronarius* and some of the Ancients, intimate, that wherever the Twig-withy, Flea-bane, Reeds, Trefoil, Pond-Grass and the Bull-Rush grow very plentifully, there you may most

most probably find Water; and he directs to find it by the following Experiment.

By digging a Ditch three Foot deep, and having a leaden Vessel or Earthen Pot, made in the Form of a Semi-Circle, rub it over with Oil at Sun-set; then having a Piece of Wood half a Foot long, well wash'd and afterwards dry'd, tie this on a small Stone on the middle of it, and fix it on the middle of the Pot or Vessel with Wax: Having done this, turn the Mouth of the Pot downwards, in the Trench that has been dug, taking Care that the Wool hang down in the middle of the Vessel; then cover the Vessel with Earth, to the thickness of a Foot, and leave it till the next Morning; and if at Sun rising you uncover it, and perceive small dewy Drops hanging on the Bottom, and the Wool wet, there is Water in the Place.

If the Wool be very full of Water, and the Drops hanging on the Pot be very large, you may thence conclude you are not very far from the Spring; but if it be only moist, tho' there be a Spring in that Place, yet you may conclude that it lies very low, and not to be come at, without great Pains and Charge: But if you do not find these Symptoms, you must make the Experiment in another Place.

Water may also be discover'd by the Nature of the Soil. If it be a black fat Soil, and abound with Pebbles of a black or yellowish Colour, you need not fear wanting Water in such a Place.

Again: If the Soil be glutinous or clayey, you may expect to find Water in it.

Again, Water or Springs may be discovered by the natural Produce of the Soil (as before) as where Water-Plantane, the Sun-Flower, Reed-Grass, Oxbane, Brambles or Shave-Grass, Calamint, Mat-Rushes, Maiden-Hair, Melilot, Sower-Sorrel or Ditch-Dock, Cinquefoil, Blood-wort, Night-Shade, Water Milfoil, or Coltsfoot grow, there you will find Springs, and where they grow in most Abundance, there you will find the most plentiful Springs.

Some make use of the following Experiment for finding Water. They dig a Ditch a Foot broad and 3 Feet deep, and about the middle of the Day, hang a dry Spunge in the midle of it for 3 Hours, covering it close with large Reeds; and if the Spunge, when it is taken from thence, is wet, they take it for an assured Sign that there is Water there, and proceed to dig; but if on the contrary the Spunge is dry, they conclude it is in vain to search for it there.

Coronarius informs us from *Democritus*, that the Discoverers of Water aver, that flat and extensive Plains are commonly most destitute of Water; whereas rising Grounds seldom fail of abounding with it; and that those Eminences, which are most shaded with Trees, have generally the greatest Share of it.

Others

Others of the Antients ſay, that wherever you can diſcover Swarms of Flies, hovering and pitching about one and the ſame Place, they are certain Signs that Water is there.

Moſt of theſe Obſervations of the Antients are agreable to thoſe of modern Practitioners.

The ſeveral Kinds of Weeds, before mentioned, are certain Indications, that Water (if it does not break out) is near at Hand. And to this it may be added, that thoſe kind of Herbs grow on mooriſh black Land, on the Sides of Hills, and where the Ground is mixt with Pebbly Gravel or Rock, that is of a duſky brown ſandy Colour.

But there is not a more certain Sign of Water in the World, than where Alder-Wood grows naturally and of its own Accord: and even the Oak it ſelf is found to grow on moiſt Hills.

After this ſhort Account of the Methods of diſcovering of Springs, their Situation, &c. I ſhall next proceed to the Operation it ſelf.

Thoſe who have been converſant in Mines and Coal-works, obſerve that there are two Sorts of Springs; thoſe that lie near the Surface, and are ſuppos'd to proceed intirely from Rain; and thoſe that lie deeper and proceed from a more remote Cauſe.

It would then be dangerous to dig deeper than the Surface where they firſt appear, leſt they ſhould take a wrong Current, and inſtead of breaking out Side-ways, ſhould ſink beneath their Cauſe, and be loſt in the Crannies and Openings of ſuch Rocks of Stone and Gravel as lie contiguous thereto; but thoſe are either ſtronger or weaker, according as they happen to lodge or fall on Earths, which are in their Nature more or leſs glutinous and clayey, and conſequently tenacious of Water; or are otherwiſe of a more arenaceous, gravelly, ſandy, or of a drying Chalk and whitiſh Earth; or which is very common, of a flinty or hollow Subſtance. Theſe uppermoſt Springs muſt therefore be ſought after with Caution; but as to ſuch as lie lower, there is no Fear of Injury.

As to the Quality of WATER.

Thoſe who ſeek for Water, ſhould firſt conſider what the Places are in which Water is to be found.

In the following Places Springs are certain and good: In Chalk, ſome ſay, it is fine, but riſes not very high; this is reckon'd the beſt Water of all.

In ſandy Gravel alſo it is fine; but if it is found in low Places (theſe are generally Rain Springs) and then it will be muddy and unſavoury; but in black Soils, there are fine thin Diſtillations found, which are collected as they ſubſide from Winter Rains in clayey Grounds, and thoſe have the beſt of Taſtes.

In Ground which is a clear Gravel, Springs abound but

little, and the Veins are not certain; but those are extraordinary sweet.

In large, pebbly Gravel, and in Sand, Stone or loose Veins of Coal, they are more stable and certain, and these have all a good Taste.

They are plenty also in Red Stone, and good, if they don't slip away, and run off through the Interventions thereof.

They flow plentifully also under the Foot of Mountains, and in Stony Places: these are very cold, but very healthy; but the Water that is found in Champion open Places (such as the Water is in all stagnated Ponds) is thick, betwixt hot and cold, and not sweet, except it be that which springs out of the Bottom of Mountains, and runs into the middle of large Plains: and where they are shaded with Trees, there they excell the Sweetness of Mountain Springs.

The Manner of discovering Springs having been before treated of, the next Thing to be considered, is the taking the exact Levels, and making proper Allowances for the Curvature of the Earth, and adjusting the Fall or Current, which is generally allow'd for the Descent of Water.

For taking of Levels, especially those that run any Distance, the following Instruments are in the most Esteem.

Of these Instruments or Levels there are various Sorts; of which I shall take Notice of but two or three.

Of all the *Levels* which have been produc'd, there is none for Portableness, Cheapness, Certainty and Dispatch, exceeds that which follows; it being what may be made or purchas'd for 8 or 10 *s.* whereas several other *Levels* will cost five or six Pounds.

This *Level* is a Tube made of Brass or other-like solid Matter, about three Foot long, and 12 or 15 Lines Diameter, whose Ends are turn'd up at Right Angles, for receiving two Glass Tubes, three or four Inches long, fastened on them with Wax or Mastic; at the middle and underneath this Tube, is fix'd a Ferril, for placing it upon its Foot: This *Level*, tho' it be a very simple one, is very commodious for levelling small Distances, says M. *Le Bion*.

An Instrument founded upon the same Reasons, tho' not made exactly in the same Manner, is describ'd as follows: It consists of a Piece of Heart of Oak, of two Inches square, in the middle of which was a large Groove, into which was fix'd a Tin Tube, of about two and a half or three Foot long; being the Length of the Piece of Wood turn'd up at the End, into which at *a a* were put in two Tubes of Glass, of an equal Length, reaching to *b b*; now into either Ends of the Glass Tubes, which are always open, you may pour in Water so high, till it reaches the prick'd Line *c c*, or thereabouts.

This Instrument may be fix'd on a Tripos, or a plain Table, or any other Instrument for Surveying,

veying, is ſlipp'd into it at B; and if it be manag'd with any Kind of Dexterity or Diſcretion, it will immediately form a *Level*, as *c c*, before mentioned, which tho' it be farther off or nearer to *a a*, is not material; the Water which is in the Tube naturally reſting on the Level, over which you are to take your View. See *Plate*, *Fig.* 1.

But if you have a Mind to enlarge your View a great way, you may frame in a little Poſt on one Side of your Level at O, which ſhall have a Screw fix'd into it at P, and may be either rais'd higher or lower at Pleaſure, as your Water is in the Tubes, through which you may have Sight to look at N° 2, 2, as you do thro' other Levels.

The Rationale of this and all Levels of this Kind, are, that Water naturally places it ſelf level; and therefore the Height of the Water in the Glaſs Tubes, will be always the ſame in Reſpect to the Centre of the Earth.

The next I ſhall mention is the *Teleſcope Spirit Level*, a genteel and ingenious Inſtrument, accounted the Invention of Mr. *William Siſſon*, being of great Uſe for thoſe who are to take the Dependance of a River (or any other Length) for 15 or 16 Miles or more.

This Inſtrument conſiſts of a braſs Teleſcope, of a convenient Length, the longer the better, provided the Parts of the Inſtrument which ſupport it, be proportionably ſtrong.

Within this Teleſcope is fix'd a Hair, and a ſmall Micrometer, whereby the Diſtances may be determined at one Station, near enough for the Buſineſs of levelling; upon this Teleſcope is fix'd with two ſmall Screws, the *Spirit Tube* and *Bubble* therein, which *Bubble* will reſt exactly in the middle of the Tube, when the Teleſcope is ſet truly level.

Under the Teleſcope is a double Spring, with two Screws, by which the Bubble is brought exactly to a Mark in the middle of the Tube; to which Spring is fix'd a conical Ferril, which is a Direction for the Teleſcope to move horizontally at Pleaſure.

There is alſo a three-legg'd Staff, a Ball, Socket, and four Screws, to adjuſt the horizontal Motion, the ſame with that belonging to all Surveying Inſtruments. See *Plate*, *Fig.* 2.

For your Aſſiſtance to this, and the other Levels before-mention'd, you muſt be provided with two Station Staves, repreſented, *Fig.* 3. each ten Foot long, that may ſlide one by the Side of the other to five Foot, for the eaſier Carriage; theſe muſt be divided into 1000 equal Parts, and numbred at every tenth Diviſion 10, 20, 30, 40, *&c.* till you come to 1000.; but every centeſimal Diviſions (which is the moſt that can be expreſs'd in the Figure before-mentioned) as 100, 200, 300, *&c.* to 1000, ought to be expreſs'd in large Figures, that the Diviſion may be more eaſily counted; and you

you may alſo have another Piece, five Foot long, divided alſo into 500 equal Parts, to be added to the former, when you ſhall ſee Occaſion.

Upon theſe Staves are two Vanes or black Boards made to ſlide up and down, which will alſo ſtand againſt any Diviſion on the Staff, by the Help of Springs; theſe Vanes are beſt made 30 Parts wide, and 90 Parts long; let the Faces of them be divided into three equal Spaces; by two Lines drawn Length ways; let the two extreme Parts be painted white, and the other two black, which will render them fit for all Diſtances. See *Plate*, *Fig*.3.

When you are thus provided with a good Inſtrument, two Station Staves, a Chain and two Aſſiſtants, you may proceed to your Work; but firſt it will be neceſſary to know if your Inſtrument be well adjuſted.

Now to do this, you are to chuſe ſome Field or Meadow, which is nearly level, and ſet down the Inſtrument about the middle thereof, and make a Hole in the Ground under the Centre of the Inſtrument, from which meaſure out a Right-Line, ſome convenient Length as 20 Chains, and there leave one of your Aſſiſtants with his Station Staff; and then return to the Inſtrument, and meaſure out the ſame Number of Chains, *viz.* 20 the other way: by the Direction of the Inſtrument and laſt Station Staff, as near in a Right-Line as you can gueſs, and there leave your other Aſſiſtant with his Station Staff, ſo will the Inſtrument and Station Staves be in a direct Line.

Then return to the Inſtrument, and ſet it horizontal, which is preſently done by Ball and Socket, and turn the Teleſcope about on its horizontal Motion to your firſt Aſſiſtant, and move the Teleſcope by the two Screws in the double Spring, till the Bubble reſts exactly in the middle of the Spirit Tube; then obſerve where the Hair cuts the Staff, and direct your Aſſiſtant to move or ſlip the Vane or Board up and down, till the Hair cuts the middle thereof, ſo that you can ſee as much of the Vane above the Hair, as is below it, and there give him a Sign to fix it; then direct the Teleſcope towards your ſecond Aſſiſtant, and proceed in the ſame Manner; ſo are the Vanes on each Staff, equi-diſtant from the Centre of the Earth.

Remove the Inſtrument to that Aſſiſtant which is neareſt the Sun, that you may have the Advantage of the other Aſſiſtant's Vane, and there ſet down the Inſtrument, as near the Staff as you can; then having ſet the Inſtrument horizontal, ſo that the Bubble reſts in the middle of the Tube, obſerve what Direction is then cut by the Hair in the Teleſcope, above or below the middle of the flat Board or Vane; for ſo many Diviſions muſt the other Aſſiſtant's Vane be elevated or depreſs'd, which you muſt direct him to do accordingly.

Here the Diſtance of the Inſtrument

ſtrument from the Station Staff is 40 Chains, for which you muſt make an Allowance for the Earth's Curvature, which, by the following Table you will find to be 16 $\frac{6}{10}$ Parts; therefore let the Vane on the Staff be raiſed 16 $\frac{6}{10}$ Parts.

Then direct the Teleſcope to the Vane thus raiſed, and if the Hair cuts the Middle thereof, while the Bubble reſts in the Middle of the Tube, the Inſtrument is right, but if not, raiſe or depreſs the Teleſcope by the Screws in the double Spring, till the Hair cuts the Middle of the Vane, and then by the Help of the Screws that fixed the Tube to the Teleſcope, move the Bubble, till it reſts in the Middle of the Tube, ſo is the Level adjuſted.

As to the Allowances to be made for the Curvature of the Earth, when the Station Staves are planted at unequal Diſtances from the Inſtrument, you muſt take the following Method.

Suppoſe the Inſtrument was placed on an Eminence between two Valleys A and B, and the firſt Aſſiſtant ſtanding with his Station at C, and the ſecond at D, and it is required to know the different Height of the Hills C and D.

Firſt, Set the Inſtrument horizontal, and then direct the Teleſcope to the firſt Aſſiſtant's Staff at C, and by the Spring Screws, ſet the Bubble exact, obſerving where the Hair cuts the Staff, and by Signs cauſe him to move the Vane higher or lower, till the Hair cuts the Middle thereof, and then give him a Sign to note down the Diviſion, cut by the upper Edge of the Vane, which ſuppoſe 104 Parts from the Ground, and by the Micrometer in the Teleſcope, find the Diſtance from the Inſtrument to the Staff C, to be about 10 Chains.

Then direct the Teleſcope to D, and proceed in the ſame Manner as before, and find that the Hair cuts 849 Parts from the Ground, and by the Micrometer, the Diſtance to D, is determined to be about 35 Chains.

Next look into the Table of Curvature following, and find againſt 10 Chains, one Part to be deducted for the Curvature of the Earth at that Diſtance, ſo will the Aſſiſtants Note be made 103 Parts.

Alſo againſt 35 Chains you will find $\frac{7}{1210}$ which being deducted out of 489, there remains 836 $\frac{3}{10}$, which muſt be noted by the ſecond Aſſiſtant.

Now if the 103, as noted by the firſt Aſſiſtant, be ſubtracted from 836 $\frac{3}{10}$, as noted by the ſecond, the Remainder will be 733 $\frac{3}{10}$, and ſo much the Hill *c* is higher than the Hill *d*.

A TABLE of the Earth's Curvature, calculated to the Thousandth Part of a Foot, at the End of every Chain, from one Chain to 40.

Chains.	Dec. Feet.	Chains.	Dec. Feet.	Chains.	Dec. Feet.	Chains.	Dec. Feet.
1	000	11	013	21	045	31	099
2	000	12	015	22	050	32	106
3	001	13	017	23	055	33	113
4	002	14	020	24	060	34	120
5	003	15	023	25	065	35	127
6	004	16	026	26	070	36	134
7	005	17	030	27	075	37	141
8	007	18	033	28	081	38	149
9	008	19	037	29	087	39	157
10	010	20	041	30	093	40	166

Thus you have a Table of the Curvature of the Earth; but, if you have not the Table at hand, or the Number required be not to be found therein, then you may find the Allowance which is to be made at any Distance by the following Rule.

Multiply the Square of the Chains by 31, and divide the Product by 300000, and you will have the Answer.

In this Manner, by making an Allowance for the Curvature of the Earth, you may send a Station Staff forwards half a Mile or farther, from the Instrument, and take a Sight over Valleys at once; the horizontal Distance being in this Case the only Thing to be regarded.

I shall now come to the Operation, by which it may be known, whether Water may be conveyed in Pipes or Trenches, from a Spring-head, to any determined Place.

At the Spring-head, set up one of your two Station Staves, as nearly perpendicular as you can, and leave with one of your Assistants, proper Directions for raising or depressing the Vane on his Staff, according to certain Signs, which you, standing at your Instrument, shall give him. Also let him be provided with Pen, Ink and Paper, to note down very carefully the Division of the Staff which the Vane shall cut, when you make a Sign that it stands in its right Position.

Carry your Instrument towards the determined Place you are

are going to, as far as you can ſee them; ſo that thro' the Teleſcope you may but ſee any Part of the Staff left behind, when the Inſtrument is ſet horizontal; and from that Place ſend your Aſſiſtant forward with his Station Staff, with the ſame Inſtructions which you gave at firſt.

Set the Inſtrument, by the Help of the Ball, Socket, and Screws, and direct the Teleſcope to your firſt Aſſiſtant's Staff, and then by the Help of the Spring-Screws, bring the Bubble exactly to the Middle of the Tube, and when it reſts there, give a Sign for your Aſſiſtant to note the Parts of the Staff.

Turn about the Teleſcope to your ſecond Aſſiſtant's Staff, and by the Spring Screws as before, ſet the Bubble exact; then direct your ſecond Aſſiſtant to move the Vane higher or lower, till you ſee the Hair in the Teleſcope cuts the middle of the Vane or Sight-board; (but in long Diſtances the Hair will almoſt cover the Vane; however let it be ſet in ſuch a Manner, that as much may be above the Hair as below it, (as near as you can gueſs) and then give him a Sign to note the Diviſion upon the Staff; and always let your Aſſiſtants note the Diviſion cut by the upper Edge of the Vane.

Let your firſt Aſſiſtant then bring his Station Staff from the Spring Head, and changing Places with the ſecond Aſſiſtant, let your ſecond Aſſiſtant carry his forwards to the determined Place, to which you are going, and at a convenient Diſtance erect it perpendicular, whilſt your firſt Aſſiſtant tarries with his Staff, where your ſecond Aſſiſtant ſtood before.

Place your Inſtrument between your two Aſſiſtants, as near the middle as you can, on account of the Curvature of the Earth, and firſt direct your Teleſcope to your firſt Aſſiſtant's Staff, and when the Teleſcope is levelled to one of the Diviſions on the Staff, let him note that Diviſion in an orderly Manner, under the firſt Obſervation; and let the ſecond Aſſiſtant do the ſame.

And in this Manner proceed over Hill and Dale, as ſtrait forwards as the Way will permit, to the appointed Place (only repeating theſe Directions) tho' it be 20 Miles diſtant from the Spring Head.

But in the whole Paſſage, let this be a conſtant Rule, from which you muſt never depart, *viz.* that your firſt Aſſiſtant muſt at every Station ſtand between the Spring Head and your Inſtrument, and your ſecond Aſſiſtant, muſt always ſtand between the Inſtrument and the appointed Place to which the Water is to be conveyed; and alſo the firſt Aſſiſtant muſt be ſure to place his Staff exactly in the Place where the ſecond ſtood.

Being come to the Place appointed, let both your Aſſiſtants give in their Notes, which ought to ſtand in the Manner and Form following.

First Assistant's Notes.		Second Assistant's Notes.	
Stations.	Parts.	Stations.	Parts.
1	1029	1	1525
2	529	2	634
3	695	3	743
4	793	4	898
5	821	5	762
6	1378	6	1354
7	724	7	891
8	227	8	1449
9	465	9	532
10	732	10	891
11	321	11	654
12	621	12	1531
Sum	8335	Sum	11364

When you have taken the Levels, and summ'd up the same, you will find the Difference of the two Assistant's Notes to be 3029 Parts, which is about 3 Foot $\frac{1}{3}$. But that you may be the more certain, it is best to try the same in another Tract, and by another good Instrument, and it may happen to be the same, which it will be very near, if the same has been rightly survey'd.

Where note, that if in the making the second Experiment, tho' you take more Stations than at the first, yet the Notes compar'd together will be, if not equal, yet will differ but very little in the Parts.

Note, If from the first Assistant's Staff you measure any Number of Chains towards the Place you are going to, as suppose 20, and then set down the Instrument, and then measure ten Chains forwarder, and there place the other Station Staff, you will have no Occasion to make any Allowance for the Curvature of the Earth, because the Instrument being planted in the Middle of the Distances between the Station-Staves, the Errors mutually destroy one another.

But this measuring the Distances, with the Chain or otherwise, is very tedious, and in some Places (where the Ground is very uneven) unpracticable, unless you make a Multitude of Stations; so if the Way between the two determined Places, whose different Heights you would know, lies over Hills and Dales, then you must in that Case make four or five

five Stations, otherwise you will not be able to see any Part of the Staff, when the Instrument is set horizontal, which might as well be done alone, as in the foregoing Observations, in the Manner described in the Table of Curvatures.

For the common Occasions of Levelling to be performed without much *Apparatus* of Instruments, Time or Trouble, the following Method is recommended.

Set a Pole upright in a Spring, Pond, River, or other Place, whence Water is to be brought, and mark how many Feet and Inches of it are above Water.

Then set up another Pole of equal Length with the other in the Place to which the Water is to be brought.

Place the Centre of a Quadrant on the Top of this last Pole, so that the Plummet may hang free; spy through the Sights the Top of the Pole that is set up in the Water, and if the Thread cuts any Degree of the Quadrant, the Water may be conveyed by a Pipe laid in the Earth.

But if you cannot see from one Pole to the other, the Operation must be repeated.

Dr. *Halley* suggests a new Method of Levelling, which has been put in Practice by some of the *French* Academy: This is performed wholly by means of the Barometer, in which the *Mercury* is found to be suspended to so much the less Height, as the Place is farther remote from the Centre of the Earth.

Hence it follows that the different Height of the Mercury in two Places, gives the Difference of the Level.

Dr. *Derham* from some Observations he made at the Top and Bottom of the Monument, found, that the Mercury fell $\frac{1}{10}$ of an Inch at every 82 Foot of perpendicular Ascent, when the Mercury is at 30 Inches.

Dr. *Halley* allows of $\frac{1}{10}$ of an Inch for every 50 Yards; which considering how accurately Barometers are now made, an Inch in some of them being divided into 100 or more Parts, all very sensible, he thinks this Method sufficiently exact to take the Level for the Conveyance of Water, and less liable to Error than the common Levels.

The same Author found a Difference of 3 Inches 8 Tenths between the Height of the Mercury at the Top and Bottom of *Snowdon* Hill in *Wales*.

Of the proper Methods to be taken in adjusting the Levels or Falls from a Spring head, so as to conduct them by a gradual Descent to the House, or other Place required.

The Descent from the Spring Head to the Reservoir being taken, the next Thing to be done, is to determine what Fall the Water is to have, or in other Words, how many Feet or Inches, or how much Dependance is to be allowed to a Yard, to a Pole, to 100 Feet or Yards, or a Mile or Miles in Proportion, so as that the Water may have a proper Cur-

rent

tent, and may at laſt not fall too low, but be brought gradually to the Top of the Reſervoir or Pond where it is to be uſed.

But before we proceed to the Adjuſtment of the Dependance or Fall of Water, it will not be improper to enquire into the Fall of ſome Aqueducts and Water-courſes, both at Home and Abroad, ſince 'tis from Fact rather than Theory and Speculation, that the certain Conſequences of this or any other Employ muſt be deducted.

Vitruvius tells us, that the *Romans* allowed for the Channels or Sewers of their Aqueducts for every 100 Feet, running half a Foot of Declination or Sloping (which is near 27 Foot in a Mile) and if any Hills were in their Way, they dug thro' them, making Vents to give Air at convenent Diſtances; they not being apprized in that early Dawn of Hydroſtaticks, that if you would confine your Spring in Leaden Pipes, it would riſe over Hill and Dale, if the Spring-head were ſo high as to over-top them, proper Allowance being made for Friction, and the Interpoſition of Air, which may be let out by Wind-cocks, as ſome Authors have taught.

The ſo much famed Aqueduct of *Claudius*, was (as Mr. *Addiſon* informs us) five Foot and a half in a Mile; but whether he means an *Italian* or *Engliſh* Mile does not appear; but if it be an *Engliſh* Mile, Experience informs us it is an Allowance large enough, tho' it were not to be above a Foot Fall in 1000.

Varenius in his Geography relates, from ſome *French* Writers, that the *Seine*, out of which the Water is carried from the *Armory* at *Paris*, to the *Royal Gardens*, is ſcarce one Foot Fall in 500 Fathoms, every Fathom being 6 Foot; now 500 being multiplied by 6, the Product is 3000 Feet, which is half a Mile, and 260 Feet, if accounted in the *Engliſh* way; by which it appears that the Fall is about two Foot in a Mile: but later Experience ſhews, that Water will deſcend in leſs than that. The Water-courſe at *Plymouth* is ſaid to be but five Inches in a Mile-Fall; and one made ſome Years ſince, by Mr. *Stephen Switzer*, for the Earl of *Coningsby*, but about four.

The *New River*, according to the Relation of Mr. *Mills* the chief Surveyor of that Work, is in the mean, but between 3 and 4 Inches Fall in a Mile; tho' in ſome Places it be more, and in others leſs: And Sir *Jonas Moore* is ſaid to allow but 3 Inches; and the ſame is practiſed in the Fens of *Lincoln* and *Cambridgeſhire*, where the Water is almoſt of a deadiſh Flat; but the general Allowance is 4 Inches and a half by all Ingeniers.

To conclude this, the conducting of Water varries according to the Conveyances in which it is carried.

 W A

Water conveyed in Pipes, especially if they are ſmall, requires more Dependance than any other Way, on account of the Friction there is againſt the Sides of the Pipes, as well as Wind-boundneſs that generally they are liable to.

That which is conveyed in Drains, will paſs more eaſily and freely; but Water paſſing in an open Carriage, will paſs the moſt free of all; except the Winds are againſt the Stream, becauſe of that continual Agitation and Pulſion that there is in the Air.

But to come to Practice: Suppoſe the Length the Water is to be conveyed is 1000 Yards, and the Fall from the Spring-head to the Reſervoir or Houſe, is 25 Foot 9 Inches, and it ſhould be required to know how many Inches or Parts of an Inch muſt be given to every Yard or Pole, in order to give this Water its proper and gradual Deſcent or Fall.

In the firſt Place, you muſt reduce the 25 Foot 9 Inches into Inches, which make 309; but thoſe not being brought into Terms low enough to be divided by 1000, you muſt reduce the 309, multiplying by 12, to bring it into Lines or Parts of an Inch, the Produce of which will be 3708, as is ſeen by the Operation.

F.		In.
25	:	9
12	:	0
300	:	0
9		
309	:	0
12	:	0
1|000)3|708	:	0(

Which being divided by 1000 the Number of Yards contained in the Length, the Quotient will be 3 Lines $\frac{708}{1000}$ of a Line, which is near 3 Lines $\frac{3}{4}$, or a Quarter and $\frac{3}{4}$ of an Inch; however you may allow it a Quarter and half Quarter, which is 4 Foot 7 Inches in a Mile, and have to ſpare, and to anſwer for any Error or ſmall Miſtake that may happen in carrying on the Work.

Suppoſe farther, that the Length of this Fall of 25 Feet 9 Inches, be 4 Miles and a Quarter, and it is required to know how many Feet or Inches it is proper to allow in a Mile, or any Part or Quantity of a Mile?

Firſt reduce the four Miles and a Quarter, into Quarters of a Mile, which making 9, by ſuch Multiplication, divide the 25 Feet 9 Inches by 9, and the Quotient is the Anſwer.

Example.

EXAMPLE.

F.	In.
25	9
12	0
9)309	0(34 $\frac{1}{3}$
39	0
34	3

And the Anſwer is 34 $\frac{1}{3}$ Feet, or two Foot 10 Inches $\frac{1}{3}$; and ſo much muſt be allowed for the Fall in a Quarter of a Mile, which is 1 Foot 5 Inches in a Furlong; and a little more than one Line or one Twelfth of an Inch to a Pole, and 11 Foot and $\frac{1}{2}$ in a whole Mile, a very good Dependance for the Paſſage and Conveyance of Water where it can be had.

But there are other Things to be conſidered, in relation to the Conveyance of Water in Pipes, *i. e.* Friction, Windboundneſs, &c. becauſe as M. *Mariotte* obſerves (and that from curious Experiments) that Water never riſes to its own Level, on account of the Friction that is on the Sides of the Pipes, which Friction increaſes the longer the Diſtance is.

Now to adjuſt this Stoppage or Friction as near as may be, the general Rule among Workmen is to allow one eighth of the Height for the Interruption it meets with in its long Paſſage.

So that if the Deſcent from a Spring-head to the Reſervoir be 128 Foot, you are according to this general Rule, to divide it by 8, and the Product will be 16.

Which ſhews that the Water will not riſe ſo high as the Spring-head by 16 Feet.

But Monſieur *Mariotte* (to whom we are ſo much indebted for his *Hydroſtaticks*) has brought this Matter to a more exact Calculation, producing it as a certain general Rule, *That the Difference of the Height in* Jets d'eau, or in other Words, *the Deſcent of the Water from its Head to the Reſervoir, or Place aſſigned for the Reception of it, is in a ſubduplicate* Ratio *of its Height.* And tho' 'tis certain, that he made Uſe of this Rule to demonſtrate the Riſe of Jets in the open Air; and as external Air has undoubtedly a greater Effect on the Riſe of Water, than the Friction againſt the Sides of the Pipes, we may be the more ſure, that if there be any Error, it is on the right Side, and that without any great Deviation from Truth, it may be applied to the Friction that is in incloſ'd Pipes.

But to proceed upon the Foot of the foregoing Rule, it is, as may be ſeen in Dr. *Deſaguliers*'s Tranſlation of M. *Mariotte*, and which has been confirmed by undoubted Experiments, that a Spring-head five Feet one Inch high, will raiſe the Water 5 Foot, and that conſequently the Friction that is allowed, is one Inch; and according to this Proportion the following Table is calculated.

A TABLE of the Heights to which Water will riſe, proceeding from Reſervoirs or Spring-Heads of different Heights; as alſo from five Foot to 100.

The Height of the Reſervoir or Spring-Head.		The Height to which Water will riſe.	
Feet	Inches.	Feet	Inch.
5	1	5	0
10	4	10	0
15	9	15	0
24	4	20	0
27	1	25	0
33	0	30	0
39	1	35	1
45	4	40	0
51	9	45	0
58	4	50	0
65	1	55	0
72	0	60	6
79	1	65	0
86	4	70	6
93	9	75	0
101	4	80	0
109	1	85	0
117	0	90	0
125	1	95	0
133	4	100	0

It has before been obſerv'd, that the weakneſs of Water that runs a great way, is a great Deal more in Proportion to the Length it runs, than to any other Cauſe, it being found by Experiments (as the learned and ingenious Dr. *Deſaguliers* tells us) that this diminution or weakening of the Water, diminiſhes rather in Proportion to the Length it runs, than to the Friction againſt the Sides of the Pipes.

But as this Diminution is Fact (let it proceed from what Cauſe it will) and as all Motions do decreaſe in Proportion to the Spaces through which they paſs, it will be proper to endeavour after a Determination, as near as poſſibly we can, that we may come the nearer to the Truth of our Calculation, in the giving this requiſite Dependance to Water, that is to run from a Spring-Head to a Reſervoir, either in Leaden or other Pipes.

And ſince this Diminution or Stop-

Stoppage is (as all other Motions are) in a ſubduplicate Ratio to the reſpective Spaces through which it paſſes, let us ſuppoſe, that as Water that falls from a Reſervoir of 133 Foot high, riſes but to 100 Foot at a 1000 Yards Diſtance, and that this Diminution beginning from thence, increaſes gradually, ſuppoſe four Inches at the firſt, and ſo on according to the fore-mention'd Ratio, then the Account may ſtand thus.

A TABLE of the Diminution or Decreaſe of Water paſſing through Pipes of great Length.

Length.	Decreaſe.	
Yards	Feet	Inches
1000	0	4
1500	0	9
2000	1	4
2500	2	1
3000	3	0
3500	4	1
4000	5	4
4500	6	9
5000	8	4
5500	10	1
6000	12	0
6500	14	1
7000	16	4
7500	18	9
8000	21	4
8500	23	1
9000	27	0
9500	30	1
10000	33	4

By which it appears that this Diminution will be 33 Feet 4 Inches in 10000 Yards, or about five Miles and three quarters or ſomething more.

And this ſeems to be the leaſt that can be allow'd, ſo that if that an exact Calculation were to be made from theſe Rules for the Deſcent of Water, for the four Miles and a half in Length before-mention'd, it would come to agree pretty nearly with what I have been endeavouring to eſtabliſh for a certain Rule, which will be viſible from the following Example, which is ſumm'd up in two Lines.

Impri-

		F.	I.
Imprimis	The Friction of 25 Feet 4 Inches —	2 :	2
Secondly,	The Diminution or Decrease in passing through 8000 Yards, which is a little more than four Miles and a half.	21 :	4
	In all	23 :	6

But notwithstanding what hath been said of this Diminution or Stoppage in Pipes of Conduct, yet in large open Aqueducts, Rivers or Sewers, (where the Friction is not sensible) there will be no Occasion for this great Care in the Calculation of the Dependance of Water.

What is endeavour'd to be establish'd from these Rules is, that though Water in an open Sewer or Drain, may pass at four, five or six Inches in a Mile Fall, yet if it be to pass thro' Pipes of Conduit, you can't allow it less than five Foot Fall, and so the Aqueducts of *Rome* are, as is before observ'd.

And tho' I will not positively assert, that Water will not pass at all with a less Allowance; yet one may venutre to say it will not pass freely.

It is plain by what has been before advanc'd, that one Foot in a Mile is Inclination enough for any River, Aqueduct or the like; it being a considerable Rule in *Hydrostaticks*, that the larger the Aqueduct or Pipe of a Conduit is, the less is the Friction, which may be so enlarg'd as not to be sensible at all.

These Things being premis'd in so plain a Manner, it may be easy for a Conductor of Springs to avoid running into an Error in attempting to perform what it is impossible for him to effect. The next Thing to be proceeded upon is, the Work.

When Water is to be convey'd about 1000 Yards, and you know from the foregoing Rules how much Fall it is proper to give in a Yard, as is set down in the foregoing Example, *viz.* a quarter of an Inch, if you proceed by the Garden Level, and ten Foot Rod, which is as good a Method as any. Let your Level be a little above ten Foot long, and exactly at the ten Foot, nail on a Piece of Wood of $\frac{3}{4}$ $\frac{1}{3}$ of an Inch thick, and beginning about a Foot or two below the common Surface of the Spring, as it is in the highest and best Seasons, or exactly at the Mark, as it is at the lowest; keep that level on which the Piece of Wood is nail'd, always from the Spring, and that will give the first Dependance.

You may, if you please, turn over the Level three or four times, and drive good square Stakes down, so that they may remain some time: and if you can see any great Length, you may with boning-Staves, (with which a good Workman should never be unprovided) bone quite through

through that View; but if you are oblig'd to go winding, then you must turn your Level over and over again, and your Level ought to be so conducted, as that the Stakes may stand just upon the Brow of the natural Ground; that your Pipe may not lie within above three Foot of the Surface; or if it be an open Sewer, you may not break up above two or three Foot, nor dig above two or three Foot deep in all sideling Ground.

To effect the same by the Water or Spirit Level, you must stand at the Spring-Head, and having turn'd your Instrument on the hanging Level, or in other plainer Words, on the Hang of the Hill where the Water is to pass; let your Assistant set forwards with a ten Foot Pole or Rod in his Hand, and holding his Hand at about four or five Foot high, let him move up and down the Hill, till the Level exactly strikes the Assistant's Head; and if you can carry it strait, let this be 70, 80, 90 or 100 Yards, more or less, according to the quarter of an Inch to the Yard Fall, as is before specified; which supposing to be 80 Yards, you are to allow ten Inches lower to your Gage; take and bone in new Pins or Stakes at every 15 Foot asunder; from which Gage you are to dig your Cut three Foot deep to lay your Pipes in; or if it be a bank'd River or Sewer, you are to throw your Stuff in all sideling Ground to the lowest Side, letting this Stake be in the middle of your Cut, whether it be either of 15 or 20 Foot, either of which are sufficient in Works of this Kind.

What is to be further observ'd upon this Head, is, that you are to creep along the Side or Precipice of the Hill, if it be for an open Sewer or Drain to be made of Brick or Stone, and to be as exact as you possibly can in your Level; but if your Conveyance be of leaden, wooden or earthen Pipes, and the Springs lie so high, as that you can command any Hills that lie between it and the House or Reservoir to which you are to carry it, and can by the Rules before given be sure, you can carry the Water over them, you may go the nearest way.

Of the conducting Water by Aqueducts, Drains, &c.

Running Water conducted in Aqueducts, is certainly to be preferr'd to Water rais'd by Engines, because Repairs, which hinder the coming in of the Water, are not so often needed, and also the Water may come easier and in greater Plenty, than when it is rais'd by Engines and brought in by Pipes; besides the Expence is generally larger in doing it at first, as well as the keeping it in Order afterwards.

Vitruvius informs us, that the Ancients in order to the bringing of Water to Towns, Cities, *&c.* after they had taken the Level, conducted it three several Ways, by Aqueducts,

ducts, Pipes of Lead and earthen Pipes, bak'd in a Potter's Furnace.

The leaden Pipes were at least nine Foot long, and they made them of bended Sheets or Plates of Lead, of different Thicknesses, according to the Proportion of the Largeness of the Pipes; these Pipes had likewise their necessary Declination or Sloping, and if any Valley was in the way (tho' by an unnecessary Expence) they made it equal to the Level with a Wall: they likewise had many Vents to give the Water Air, and to know where to mend the Pipes, when they wanted repairing.

And these by the Description given of them, are much stronger than the Mould Pipes now made.

The Ancients (as has been before intimated) chose rather to bring their Water in large Aqueducts, that were so high, that a Man might go upright, in order as it may be suppos'd, to mend the Pipes, and had three or four kinds of Water brought from different Springs for different Uses, in different Pipes; so that the whole Structure of their Conveyances for Water, was of an immense Height, and brought at an immense Expence, which had certainly the good Effect of keeping the Water clean and pure, as it came out of the Spring; whereas Water that is brought in open Carriages, as that of the *New River* to *Islington*, and other Waters are, is subject to be rendred foul by Land Floods, and to receive a kind of muddy Taste and Tincture from the several Soils through which it passes, in those so great Distances it is usually brought.

But as these are immense Expences, and such as are scarce consistent with the Purses of any, but the greatest and most opulent Princes and States; and as such inclos'd Aqueducts with Pipes, some of them but of a moderate Size, are not likely to supply Gardens and Cities and Towns with such large Quantities of Water, which are there wanted, these open Carriages are absolutely necessary, especially where the Property of the Ground thro' which you bring them is easily to be come at; that they are to be approv'd on before inclos'd Aqueducts, both as to the Cheapness, and also as to the Quantity of Water they convey.

To all which we may add, that altho' the Water may be rendred sometimes a little thick or muddy by Land-Floods, &c. yet by the Influence of the Sun and open Air, it is at the same time rendred sweeter, and freed from those corroding Qualities, that often render them injurious to Man, Beasts, Plants, &c. all Plants thriving better by Water that is taken out of Ponds or Rivers which run gently, than out of cold Springs.

The next Thing to be considered, is the *Profile* or Dimensions of such an open Current or Course of Water; after which I shall consider the inclos'd ones of more ancient

which do indeed bring Water to any Place clearer and leſs turbid, and therefore the fitter for drinking, &c.

The *Profile* or Depth and Breadth of ſuch Carriages, may be according to the Quantity of Water you want, or according to the Supply you have, tho' it ſhould ſcarce be leſs than four or five Yards wide at the Top, and four Feet deep. that there may be Room for that Sediment, which Water naturally obtains, by running through Soils of different Qualities; beſides ſuch a Depth requiring Banks that are ſloping, to which there ought not to be allow'd leſs than one and a half or two Foot horizontal for one Foot perpendicular; leſs width than that, will not do well; but if it is deſign'd to be a navigable Channel for larger Boats, then you ought not to allow leſs than 30 or 40, as the Canals that go between Town and Town in *Holland* generally are.

I ſhall now give ſome Direction how this open Carriage or Drain ought to be made.

In the firſt Place, you ought to keep up as much as you can in the whole Ground; and by the Side of ſuch Hill or Valley that lies near you; for that no Banking can be ſuppos'd of equal Solidity and Security with ſettled Ground; alſo all Sorts of Trees muſt be clear'd away, for the Roots of old Trees will rot and let the Water out, and the Roots of young Trees will be equally injurious; in that they will by the blowing of the Wind looſen the Banks to that Degree, that much of the Water will run to waſte there: to which may be added, that rocky Ground, Fox and Rabbit Earths, are Soils not proper for ſuch Works.

If good Clay can be procured near at Hand, it is requiſite it ſhould, eſpecially where there is a Neceſſity of raiſing Banks entirely new, or for the ſtopping of Rocks, Fox or Rabbit Earths, &c. but in other Grounds, where Paſſage is through that which is whole, there will not be Occaſion for that great Care; eſpecially if your ſupply be any Thing conſiderable; but one of the chief Cares will be to cloſe your Joints well between your new and old Ground, and when you build new Banks on old Ground, you muſt not fail to go down with your new Clay or Ballaſt, two or three Foot lower than that Ground, and two or three Foot wide, and you muſt always mix your old and new Ground together with a Toothing, after the ſame Manner as Bricklayers do, who leave it for one Brick to join to another.

It is certain, that whether it be Ballaſt or ſtrong or indifferent Clay, it is very neceſſary to ram it; or to lay the *Strata* but a Foot thick at a time, or thereabouts cauſing the Labourers to tread or wheel it over, keeping as exact a Slope towards the Trench, as if it were for a Garden, and it will be proper to fill all hollow Places with waſte Earth; not ſo much for ſaving or holding Water, as for giving a proper Baſe

Baſe and ſupport to the Foot of the Bank.

The inward Sides of the Slope of the Bank, ſhould alſo be well beaten with a large Hedge Stake, before they are pared with a Spade, which ought to be done. You ſhould not allow leſs than ſix or eight Inches, or a Foot in a Mile (if it can conveniently be had) Dependance; but for certain four or five Inches is abſolutely neceſſary.

The next Method of conducting *Water*, is what was us'd by the Ancients in their inclos'd Aqueducts: but this (as has been ſaid before) is ſo very expenſive, I ſhall ſay but little of it here; but refer any curious Perſons to the Writings of *Fabretti*, which may be had at ſome Bookſellers, and from him *Monſieur Montfaucon*, who has given the Draught of the famous Aqueduct of *Metz* and ſome others; nor are the Works of *Vitruvius*, *Palladio* and other Architects of *Rome*, to be paſs'd by on this Occaſion.

But to come to the Works made uſe of by the Moderns.

The firſt is that of Aqueducts made of Brick or Stone, in neither of which do the Moderns run to that Expence the Ancients did, neither making them ſo large, nor any way ſo expenſive.

A Drain of a Foot ſquare on the inſide, made with either of the two Materials, Stone or Brick (but Brick is the deareſt) the other not coſting above 10 *d.* or 12 *d.* a Yard, as a modern Hydrauliſt ſays, tho' at that Size they will convey vaſt Quantities of Water; but the greateſt Inconvenience that attends them, is that if the Water is to be convey'd a-croſs a Valley from one Hill to another, theſe Drains of Stone or Brick will not do it, and can only be us'd where the Water is to run ſtrait, or is to turn round upon a Precipice or Side of an Hill upon one Level.

Indeed wooden Troughs may be laid a-croſs Valleys ſupported with Frames of Wood; but theſe are attended with many Inconveniencies; as the Drought in Summer which will chap and tear them to Pieces; ſo that the Water will be in Danger of being loſt, or the Trough liable to be cut or broke to Pieces, by miſchievous Perſons; in all which Caſes Under-ground Conveyances in wooden, leaden or earthen Pipes are the beſt.

But wherever a Drain can be carried ſtrait (or even round) and the Declination is eaſy and gradual, there Brick or Stone Aqueducts and Conveyances are the beſt and cheapeſt; eſpecially where the Spring is large, as ſix or eight Inches Bore, which then muſt alſo be laid in very good Mortar in the Spring, and be ſuffered to dry before the Spring is turn'd into it; it muſt alſo be bedded in Clay; and when it is cover'd over at the Top (as it ought to be) with flat Stone, you muſt ram in Clay on both Sides and Top of the ſame, to prevent the iſſuing out of the Water.

But the Brick Drain is the next in Courſe: theſe cannot

well be made above ſix or ſeven Inches ſquare in the Inſide, becauſe a good large Brick which is laid at the Bottom and Top, is not above nine Inches long, and it muſt lap over an Inch on each Side at the Top, and at the Bottom there muſt be a Stretching Brick on each Side, to ſupport the Side Wall and Back, or rather the End. The Conſtruction of this Drain you may ſee *Plate, Fig.* 4. where the Bricks are plac'd header and ſtretcher, in the Manner they are when made into a Drain; the middle Brick mark'd A, may be any broken Bricks.

Every Yard will take up about 75 Bricks, which at 18 *d. per* Hundred, comes to between 13 and 14 Pence, and the Lime and ſetting may be worth about Two Pence, and the Digging and Claying a Groat or Five Pence, in the whole about 20 Pence; and perhaps in ſome Countries where Materials and Workmanſhip are cheaper, it may be done for 16 or 18 Pence a Yard.

But there is yet another cheaper way of Brick-Drain: and that is when a Hollow or Semi-Circle of two or three Inches in Bricks, is made about four or five Inches thick, and the uſual Length.

Theſe Bricks when plac'd together, and when ſet in Terras or very ſtrong Mortar, well dry'd before the Drain is us'd, is the cheapeſt and moſt durable Method of any for Conveyance of Water; about eight Bricks will do a Yard, which Bricks are worth 3 *s. per* Hundred, the eighth Part of which is 4½ *d.* and the digging and laying and Mortar, may be worth about 3 *d.* or 4 *d.* more, and this is the cheapeſt Method of all; but muſt be laid in Clay, as all other Drains and Pipes ſhould be.

Of the ſeveral kinds of Pipes for the Conveyance of Water, whether Lead, Iron, Earth or Wood.

Vitruvius informs us that the Ancients had but two Sorts of Pipes for the Conveyance of Water; the firſt were made of Lead, which was of Sheets nine Foot long, and turn'd in at Top, not unlike ſome made in *England*, eſpecially for Eſq. *Dodington* at *Gunville* in *Dorſetſhire*, by Mr. *Watts*, a Plumber of *Brackley* in *Northampton-ſhire*.

Theſe Pipes are join'd together without Solder, by what are by the Workmen call'd Flankets, which are Rings made of Iron, that may be ſcrew'd as tight as you pleaſe at the Joint; the Noſe of one Pipe going into the Tail of another; and in order to keep the Water from getting out at the Joint, there are proper Bandages of Leather that cloſe it up by the Compreſſion of the Flankets, under which may alſo be put Tow made of Hemp, dipp'd either in Oil, Pitch or Tallow, which will make a cloſe Cement to keep the Water in, and over which the ſaid Flankets are ſcrew'd.

Theſe

These kind of Pipes are much preferable to thoſe made in Moulds, becauſe they are caſt without thoſe Flaws and Holes, which often happen in moulded Pipes; and as they are turned in at Top and burnt (as it is termed by Workmen) they are much ſtronger.

Nor is there that Expence in Solder (beſides many other Advantages, which will be mentioned elſewhere) which is in other Pipes.

It is true, they are dearer than other Pipes are, and are chiefly fit for ſuch as have well furniſhed Purſes, but then they are far more durable.

But the cheapeſt kind of Pipes, which are now in uſe, is thoſe made of Earth; for which Mr. *Edwards* of *Monmouth* has a Patent: *Vitruvius* tells us, that the *Romans* had ſuch kinds of Pipes made of Potters Clay, two Inches thick, and joined together with Mortar mixed with Oil, and when they had a Joint to make, they made uſe of a Red Free-ſtone, which they pierced thro' to receive the two Ends of the Pipes, and to ſtrengthen and ſecure them in the Nature of a Bandage.

It is related, that ſome of theſe Pipes have been found about the City of *London*, which by ſeveral Circumſtances are ſuppoſed to have been laid by the *Romans*, when they inhabited this Iſland; but the Joints of theſe were ſecured by a Piece of Sheet-lead, which was wrapped round the Joint; ſome ſuch have been ſaid to be taken up in *Hyde-Park*, belonging to the ancient Water-works there.

Theſe Earthen Pipes now made by the ſaid Mr. *Edwards*, are about 3 or 4 Foot long, and not above half an Inch thick; but they are ſo exactly made and fitted in the Joint that no Water can come out of them.

The Price at which they are ſold, is from 1 *s.* to 2 *s.* or 2 *s.* 6 *d.* *per* Yard, and ſometimes cheaper, according as they are in Diameter; and are very uſeful in all ſuch Places where they can lie free from being gone over by Carts and Coaches.

But beſides what are made by Mr. *Edwards* in the Country, there are others made by Mr. *Aaron Mutchel* of *Vauxhall* for the ſaid Patentee; theſe are excellently good, he having been one of the firſt Inventors of them.

There was a Trial of theſe Pipes made at the *York-Buildings*, before Dr. *Deſaguliers*, and the Plumber of the Works themſelves, when being fairly tried with all the Compreſſion of Air, and that Engine could lay upon them, and without making the leaſt Fracture, either in the Pipes or the Cement which joined the Pipes together, a general Account of which was publiſhed in the Evening Poſt, of *Auguſt* 1. 1728.

Theſe Pipes are made of a Sort of Clay equal to that of which the Tiles of the Ancient *Romans* were made, are alſo uſed in the Inſides of the Walls of Houſes, and are affixed likewiſe to the Outſides of the

ſame in the manner as Lead is; even from the lowermoſt to the uppermoſt Floor; and receive and diſcharge the Water from the Roof and Gutters of ſuch Houſes, as effectually as any Pipes made of Lead or Wood, and the Price of them ſcarce amounts to one ſixth Part of thoſe of Lead, nor more than one half the Price of thoſe of Wood.

There are alſo many other Sorts of Pipes which have been uſed by the Moderns, which were, (as appears by what *Vitruvius* has written) intirely unknown to the Ancients, ſuch as thoſe of Wood, as Alder, Elm, Oak, Beech and Iron, the laſt of which are uſed in *France*, more than in any other Place) but have not, till of late, obtained in *England*.

Pipes made of Alder, are the cheapeſt of all, tho' they are not indeed the ſtrongeſt; the boreing of the Wood being not worth above 10 *d*. or 12 *d*. a Yard; but the Diameter of ſuch Pipes is generally but ſmall, about an Inch and half, and two Inches, being the utmoſt Bore it is capable of having; nor is it ſtrong enough to bear much Force; but only to conduct a ſmall Spring a ſmall Length, and upon a gentle Current.

The Pump-makers and Pipe-makers about *London*, make uſe of Fir for Pipes, where the Stream is not great, which boreing eaſy, is cheaper than that of Elm; but then on the other hand, it is not ſo ſtrong or durable as Alder Pipes are, and is only fit for Works, where neither the Riſe nor Declivity are either of them great.

Elm-pipes are much ſtronger than any of the former, and of known uſe for the Conveyance of Water, becauſe it will lie longer under Ground in the wet and Water, than any other Sort of Pipes of Wood, (Oak excepted) will.

Now theſe being generally made of ſmall Trees and Saplings, of different Diameters, they are alſo different in Prices: becauſe they will according to their Size, be either ſtronger or weaker, and of Conſequence bear either a greater or a leſſer Force, that proceeds either from the Force or Lifting of a Wheel, or the Cylindrical Weight of Water, which lies upon them, where Reſervoirs lie high; and the Reaſon that Water Works often miſcarry, is for Want of Care and Judgment in this kind of Pipes, by making the Bores larger than they ought to be, and the Outſide or Shell too thin, eſpecially in veiny crooked Trees.

Elm, ſays a modern ingenious Author, may be cut down, hewed or bored. from 8 *d*. 10 *d*. 12 *d*. to 16, 18, or 20 *d*. a Yard, running Timber and all, 5 or 6 *d*. a Yard, boring being a ſufficient Allowance.

He tells us, he has examined the Prices of Elm-pipes about *London*, and finds as before hinted, that they are according to the Thickneſs or

Strength

Strength of the Pipes, which ought to be either more or leſs, according to the Weight they are to ſuſtain.

Theſe following being the Sizes that are generally uſed, the Prices, taken at a Medium, are,

		s.	d.	
2 Inch Pipe	is worth about	1	3	*per* Yard.
3 Inch Pipe		2	0	
4 Inch Pipe		2	6	
5 Inch Pipe		3	0	
6 Inch Pipe		4	6	
7 Inch Pipe		5	0	

Thoſe who make the moſt Objections againſt Elm-pipes, urge, that there is a great Waſte of Water at every Stroke of the Engine, which forces the Water, with great Violence, thro' the Pores of the Tree; but this Objection is anſwered, by the Suppoſition that it is an Eaſe to the Work, and not at all different from Nature; but rather a Relief than a Burden to the Machine, and the Paſſage of the Water in the Pipes; which in cloſer Bodies is frequently ſo wind-bound, that it won't paſs.

There is another Conveniency which attends theſe and all other Wooden-pipes; and that is, that you may at any Time, when the Pipes are wind-bound, which they often are, when they lie long in the Ground unus'd, that then you may bore a Hole at the very Place where you perceive the Stoppage to be, which is what cannot be ſo well in other Pipes which are made of Metal.

There is another Sort of Elm-pipes, which ſome ſuppoſe to be as ſtrong, if not ſtronger and more durable than the former, and theſe are ſquare Pipes made of Elm-plank.

The Boards of which thoſe Pipes are made, are generally about 10 Inches ſquare, and an Inch and 3 quarters thick; but they may, if you pleaſe, make them a Foot or 14 Inches ſquare; but then they ought to be 2 Inches, or 2 Inches and a Quarter, or 2 Inches and a half thick.

The Sides muſt be well grooved into the Bottom and Top, and the Joints well pitched or ſtuffed with Tow or Hemp, dipped into Pitch and Tar, to keep the Water from oozing out; after which they are to be banded and collared, at about 5 or 6 Feet aſunder, with Collars or Bands made of Elm Slabs or Planks, cut out of the Sides of the Elm, and this will be ſtronger and more durable than any other Bandages are, and will ſave Iron-hoops, which are expenſive. This is ſaid to be the Invention of *John Thyrle Ernly*, Eſq; of *Whetham*, near *Sandy-lane*, *Wilts*,

Wilts, in the Road to *Bath*.

A Board or Boards of 10 Inches square, will when well groov'd in at Top, make a square Pipe of about 4 Inches and a half, or 5 Inches square, which last is near equal to a circular Pipe of 6 Inches Diameter.

In order to proceed in this Work, you must be provided with Tow or coarse Hemp, as also Pitch and Tar, and dipping the Tow or Hemp into the Tar, put it into the Groove or Joint, and then let the Workmen knock the Boards together in the Groove, with all the Might and Strength they have; the Security of the Water in the Pipes consisting in the Closeness of this Joint.

When this has been done, then the Collar or Bandage is to be put on at each Joint, the Boards being about 9 or 10 Foot long, and another Collar in the Middle; putting the small End of one (so made as is done in Elm-pipes which are so bored) into the great End of the other.

The Conveniencies of this Sort of Conveyance for Water, are, that it is stronger, and also may be made 5, 6 or 7 Inches square, which will carry more Water than bored Elm-pipes of the same Diameter.

In the next Place, there is less Depopulation and Waste in cutting (a few large Elms at full Growth, being sufficient for this Purpose) whereas when they are cut down small, there is great Waste made; and in the last Place, it being all Heart, it will not be so subject to break or burst as Elm bored will.

Here follows the Expence of 330 Yards running, perform'd in the County of *Wilts*, by Mr. *Switzer*.

	l.	*s.*	*d.*
For 20 Tun of Timber at 30 *s. per* Tun	30	00	00
Felling and hewing of *Ditto*, at 8 *s. per* Tun	08	00	00
For Workmanship 330 Yards, at 4 *d. per* Yard.	05	10	00
For Nails, Tar, Tow, or Hemp, Banding, Collaring, and laying included at 3 *d. per* Yard.	04	02	06
	47	12	06

By which it appears that the whole 330 Yards comes to 47 *l.* 12 *s.* 6 *d.* which being reduced into Shillings, Pence and Farthings, and divided by 330 Yards, it comes to about 2 *s.* 10 *d.* a Yard; whereas Leaden-pipes of such Dimension would cost at least 20 *d.* a Yard, and bored Elm, five or six Shillings.

But supposing the Workmanship (as it is) too little by 2 *d.* a Yard, it will be vastly cheaper than either Lead or Wood.

Another

Another Sort of Wooden-pipes are made of Beech, which being of a more firm and solid Contexture, and not so porous as either Elm or Oak, will lie under Ground longer than either of them, as may be seen in all Mill-work, in which this Wood is much used; but like many other Woods, has an Inconveniency attending it, that it bores pretty hard, is brittle, and not so tough grain'd as Elm or Oak is; besides the Boughs don't run in the general so strait as Elm does, and therefore the Shell of it ought to be very thick, not less than five or six Inches to keep it from bursting; and for that reason the Bulk or Dimensions of it ought to be 12 or 14 Inches Diameter, one with another, when you may venture at a Pipe of two or three Inches bore, and tho' it is something difficult to bore, yet the Water will be less subject to ooze out, than at any of the others, Oak it self not excepted.

These Sort of Pipes, the Property of the Wood, digging the Trench, boring, laying, claying and banding, will be worth 3 *s.* or 3 *s.* 6 *d. per* Yard, for a Bore of 4 Inches, and so on proportionably less, as the Wood or the Bore is less: but then it must be observed, that it is the nearest the Goodness of Lead of any Thing that is a 4 Inch Pipe, which of Lead will cost 15 or 16 *s.* as will be made out anon.

The very last kind of Wooden Pipe is Oak, which indeed is very strong, and lasts a great while, there being some Trees of that kind which were dug out of the Foundation of *Blenheim* Bridge, (as Mr. *Switzer* says, when he was Supervisor there) that were, tho' as black as Ebony, yet as sound as *Brazil* it self, and might in all Probability have no other Date than that of the Deluge it self. But as the Limbs are generally crooked, and that all the young Bodies, together with the whole Timber it self, is too good for those Purposes, there is no need to say any more of it upon this Head.

The next Sort of Pipes to be spoken of, are those made of Potters Earth; there are at least 2 kinds of these; they are of two Thicknesses in the Shell, the first being the most in use in the Country, is not above the Thickness of two Crown Pieces at the most; but this is so thin, it is only fit to convey Water a little Way, where the Fall is not great. These are said to be bought in many Places in the West, for 6 *d.* a Yard.

The other is the new invented ones already spoken of, which nevertheless are not above half an Inch thick in the Shell; the Potter who makes them being of Opinion,, that a greater Thickness would be entirely useless; or perhaps the true Reason may be, they can't burn them so well.

These indeed are excellent Pipes well glaz'd on the Inside, as they ought to be, to keep Water sweet; and how they will perform in Force-work, an

Account has already been given.

Indeed ſome Perſons ſay, there is indeed a Weed apt to grow at the Place, where they are jointed together, the Fibres of which are apt to choak the Pipe; but this, if true, may certainly be prevented; by putting on a thin Bandage of Lead round the Joint, or a Collar of Stone and Wood to ſtrengthen them, you may prevent that Miſchief.

The Manner of mending them, when broke, has been another Objection, that has been made againſt them; for if the Joint be made of ſuch a Cement, as that the Pipe will break any where, rather than there, it does not ſeem eaſy to ſay, how they will be mended. But in Anſwer to this, the Joints of thoſe Pipes made at *Vaux-hall*, will ſhoot ſo cloſe together, that there is little Occaſion for any Cement at all; but if they do, Tow dipped in Pitch and Tar, or any other Cement of that kind, will effectually ſtop it, at leaſt the Loſs of Water will not be great, where the ſupply is any thing large, and then they may be uncollared and mended at pleaſure.

There is one Thing however to be minded; that is, that they will not ſerve in High-ways and Streets, where Carriages and Coaches are to croſs them; but on all other Accounts they are not only cheap Conveyances, but alſo excellent Pipes.

Of all Sorts of Pipes for the Conveyance of Water, that of Lead is preferable (eſpecially thoſe which are made of Sheet-lead and burnt at Top, if it were not for the Expence, becauſe they are more pliable to lay up and down Hill, and may be alſo more eaſily and firmly jointed to one another; or, as durable as any, and if well caſt, of a much cloſer Contexture.

In Pipes of Conduct, and where Water is carried a great Way, theſe Pipes ought to be 6 or 7 Inches Diameter, but muſt not be leſs than 4 or 5; becauſe in Pipes of that Size, there is leſs Friction and Windboundneſs than in thoſe that are ſmaller, and conſequently the Water will flow the better, and more regularly riſe up to the Height of its firſt Head, and alſo in greater Quantities.

It muſt indeed be own'd, that a Pipe of Conduct of ſo large a Dimenſion of 6 or 7 Inches, is ſuch an Expence as few Gentlemen, or even Noblemen will be willing to be at, in very great Lengths, where the Expence is almoſt immenſe; Pipes of that kind, without a Shell of Thickneſs proportionable to it, being worth from 25 to 40 *s.* a Yard, according to the Height of the Reſervoir, or the Force of the Water they are to ſuſtain.

Therefore a Pipe of Conduct of the cheapeſt Kind, muſt be at leaſt 4 Inches and a half, or 5 Inches Diameter, and ſuch will not coſt leſs than 16 or 18 *s.* a Yard. And for this Reaſon, in many Places, they have reduced their Pipes of Conduct to three Inches Diameter, which is indeed too little. This

it is true, reduces the Expence to 10 or 12 *s. per* Yard, according as the Price of Lead is.

Suppose Lead, casting of Pipes, and all is reckoned at 22 *s. per* Hundred Weight, the Calculation may be as follows.

To a Pipe of 3 Inches Bore, is usually allowed 45 Pounds a Yard; and this is worth about 9 or 10 *s. per* Yard, when Lead is worth from 22 to 45 *s. per* Hundred, allowing for Waste.

To a Pipe of 22 Inches, 3 Quarters, 40 Pounds is allowed, which is worth between 8 and 9 *s. per* Yard.

To a Pipe of two Inches and a half, 36 Pounds is allowed, and then it is worth about 7 or 8 *s. per* Yard; but it would be proper to add 5 Pounds more to every Yard, tho' it does add something to the Expence.

To a Pipe of two Inches Diameter, there is allowed usually 30 Pound of Lead, and then it is worth about 6 *s. per* Yard.

But of all the Pipes of Lead, of what Size soever, those that are joined by Flankets (as has been already mentioned) are the best; because they may be easily taken up, and scowred or cleansed, whenever there is Occasion.

Because as M. *Mariotte* observes, there is, even in the finest Water, a Sediment, which will in Time petrify, incrustate and grow hard, and will stop up the Pipe, which can never be cleansed again, where the Pipes are soldered together at the Joints with Solder, as Pipes generally are. And this (among some others) is one of the Inconveniencies which attend all Water-works, and is the Occasion of their being spoiled.

Notwithstanding something has been already said, concerning the Lead proper to be allowed to Pipes in general, according to the Proportion or Diameter of their Holes: but when Reservatories are very high, or Water is raised by an Engine to great Heights, or carried to great Distances, there Pipes of Conduct are in great Danger of being often broke, if the Shell is not thick enough, especially up and down Hills, and through deep Vallies, and it would render a person very uneasy, after he has been at a great Expence, if his Pipes should happen to burst thro' the Defect of the Solder, or the Weakness of the Pipes. At the same time, Care should be also taken, on the other hand, not to make them thicker than is absolutely necessary, since a small Addition in long Lengths would greatly enhance the Price.

But it is requisite, that we should know by Experience (as well as from what M. *Mariotte* and others have delivered upon this Head) that the Thickness of the Metal or Shell of the Pipes, be increas'd or diminished in Proportion to their Diameters, the Heights of the Reservoirs from which the Water falls, or the Height to which it is to be raised by Engines; and last of all, the

Lengths or Diſtances, which Water is to be carried: All which adds to its cylindrical Weight; and of Conſequence the greateſt Thickneſs of Metal in the Pipes.

As for Example, according to Mr. *Mariotte*, when a Reſervoir is 60 Foot high, and the Pipe 3 Inches Diameter, the Metal muſt be half an Inch in Thickneſs, which is the 24th Part of a Foot; but as it is not to be doubted, but that M. *Mariotte* means Copper, which is harder, ſtronger and of a cloſer Contexture than Lead, therefore 3 or 4 whole Lines, which is one fourth or third Part of an Inch, will be Thickneſs little enough, and for a Reſervoir 100 or 120 Foot high, a whole Inch, becauſe of its great Height.

If the Pipes are both wider and higher, then the two Proportions muſt be alſo obſerv'd: Thus,

If a Pipe comes from a Height of 60 Foot, and the Diameter be 6 or 8 Inches, you muſt take the half Line in Copper, according to M. *Mariotte*, or rather 3 Lines or the Quarter of an Inch in Lead, becauſe of its Height of 60 Foot; and for the Thickneſs, you muſt work by the Rule of Three, ſaying,

If 9, the Square of 3 Inches, require 3 Lines thick of Metal, What will 36 the Square of 6 Inches require?

EXAMPLE.

As 9 is to 3, ſo is 36 to a fourth Number required.

3

9)108(12 Lines is the Anſwer.

18

So that a Pipe of 6 Inches Diameter, when it comes from a Reſervoir 60 Foot high, ſhould be 12 Lines, or one Inch thick, near, or according to which, the following Table is calculatd.

But firſt of all there is another Thing to be determined, and that is the Diameter of the Ajutages.

The Author of the Theory and Practice of Gardening, tells us, that it may be taken for a certain Rule, that the Bore of the Ajutage ought to be four Times leſs than the Bore or Diameter of the Pipe of Conduct; that is, it ſhould be in a quadruple Proportion to it; ſo that the Column of Water may be proportionable, and the Quickneſs of the Motion in the Pipes may be equal.

And beſides (as has been already obſerved) there is too great a Friction or Wear in ſmall Pipes, when the Quill is too big, and in the Bore of ſmall Quills, when Pipes are too large: All theſe Things do alſo depend upon Calculations of

of this Kind, which will be necessarily included in a Table, where the Diameter of Pipes of Conduct, Thickness of Metal, &c. are contained.

Now the Calculations of M. *Mariotte* being supposed to be of Copper, Lead, not being so much used in *France*, as it is in *England*, it has been thought proper, by an ingenious modern Author, to pitch upon a Pattern of a Leaden one, which should determine all that is required on this Subject; which he tells us he has done from a Pattern, which, by all good Judges, is accounted an excellent one.

The Pipe is four Inches Diameter, which is generally supposed a good Pipe of Conduct (tho' in some Cases more may be requisite) and about equal to the Expence that most Noblemen and Gentlemen may be willing to be at.

The Thickness of the Metal which is of Lead, is 6 Lines or half an Inch, to regulate then the Thickness of other Metal to it, say as before:

If 16, the Square of 4 Inches, requires 6 Lines; how much does 36, the Square of 6, require?

EXAMPLE.

$$16 : 6 :: 36$$

$$\begin{array}{r} 6 \\ \hline 16)216(13\tfrac{1}{2} \text{ the Answer.} \\ 56 \\ \hline 8 \end{array}$$

By rejecting the Fraction, it appears, that the Thickness of the Metal requires to be 13 Lines, or one Inch one Twelfth; and upon this Foot the said Author has formed the Column concerning the Thickness of Metal in Pipes, which seems to be (without any considerable Variation) agreeable to Truth, which expresses also the Height that the Water coming from the Reservoir will rise. The following is the Table.

The

The Height of the Refervoir.		The Diameter of the Pipes.		The Thickneſs of the Metal.		The Diameters of the Ajutages.		The Height the Water will riſe to.	
Feet.	Inch.	Inches.	Lines.	Lines.		Lines.	Parts.	Feet.	Inch.
100	0	7	00	15 ½	16	12 or	15	80	00
86	4	6	00	14	00	12	14	70	00
72	0	5 ½	00	12	13	10	12	60	00
58	4	5	00	9	9	8	10	50	00
45	4	4 ¼	00	7 ½	8	7	08	40	00
33	0	3	00	6 ½	7	7	00	30	00
21	4	2 ½	00	5 ½	6	6 ½	00	20	00
15	9	2 ¼	00	4	5	6	00	15	00
10	4	0	25	3 ½	4	5	00	10	00
5	1	0	22	3	3½	4	00	5	00

This may ſuffice as to the Diameter of Pipes of Conduct, the Thickneſs of the Metal, the Diameter of the Ajutages, &c. as are, or ought to be proportionable the one to the other.

But if any Perſon has a mind to have his Pipes of Conduct larger than any above mentioned, he may; this Table being chiefly calculated for all proportionable Heights.

Iron-Pipes now growing into great Uſe, and being, in reſpect to their Cheapneſs, the beſt Pipes, thoſe of Clay excepted, which are now made, eſpecially, if the Metal is well proportioned and melted, I ſhall add concerning them.

That it will be no great Advantage to caſt them very ſmall; the beſt Sizes being from 7 or 8, to 5, 4 or 3 Inches Diameter; the firſt of which will coſt about 20 *s.* a Yard, which is much about half the Price of Lead, and the leſſer from 16, to 15, 14, 12 or 10 *s. per* Yard, according as they are greater or ſmaller in Bulk or Diameter,

Theſe Iron-Pipes are the moſt durable of any yet mentioned; they are caſt in Lengths of 3 or 6 Feet, and ſometimes 9, and are joined together by Flanckets, as may be ſeen in the Water Works at *London* Bridge. Theſe, if well made, will laſt, as one may ſay, for ever.

Theſe Iron-Pipes are to be had of Mr. *Bowen*, at his Foundery, near *Marigold-Stairs, Southwark.*

As to the Method of making Reservoirs, Basons, &c. their Construction, Extent, Depth, and other Dimensions, take the following Directions.

Vitruvius informs us, that the Ancients, in making their Wells and Cisterns, to receive Rain and other Water, used to make them under Ground, and to a very large Extent; and Walls were built on the Sides and Bottom with Mortar made of strong Lime, Sand, and Pebbles, well beaten together; claying, as we may suppose, not being so well known to them, or to be had in such Quantities, as now it is.

Of these they made several, one after another, thro' which the Water was to pass, to the End, that the Sediment might remain (if any there was) in the first and second, and so that when the Water was arrived at the last, it might be clear. They likewise put Salt into their Cistern Water to make it more subtile.

In this Manner were the remarkable Cisterns of *Roselayn* made, *viz.* with no other Materials, as has been already intimated, than Gravel and small Pebbles consolidated together, by a strong tenacious Cement, not improbably, such as Terras-mortar, or the like.

But a better and cheaper Way, is to have the Hills of the finest Sand, that can be conveniently procured, such as in its own Nature, is not subject to be dirty.

When the Water comes in, then let it be at one End, having 3 or 4 of these Sand-banks lying across the Reservoir, give the Water Time to filtre thro', and let the Pipe which is to supply the Fountain lie at the farther End. So you may expect to have your Water clear; and these Sand-Banks should lie, and be above the Surface of the Water when it is at the highest of all.

Nor can too great Care be taken in making those useful Reservatories, as daily Experience shews, especially if it be upon a dry Gravel, or sandy Bank, and is to lie above Ground, as is evident from that very handsome one behind his Grace the Duke of *Chandois*'s intended Building near *Cavendish* Square, where the Expence of making and fitting it, has doubtless been very great.

As to the Form in which these Reservoirs or Basons are made, it is of no great Consequence, whether it be a perfect Square or an oblong (which are the best Figures) or any other; and as to their Extent, that ought to be according to the Quantity of Water that is required, 100, 150 or 200 Foot square, being sufficient in most Cases; tho' for large Cities, Towns, *&c.* 300, 400 or 500 is little enough.

But the deeper they are the better, contrary to the Practice of some Persons, who have made them not more than 3 or 4 Foot deep, when they ought rather to have been from 7 or 8, to 10 or 12 Foot deep, that the

the Water may settle the better.

The Bottom also ought to be filled, 2 or 3 Foot high, with large Gravel Pebbles, by which Means the Sediment will have Room to lodge and settle therein; and this Bottom should be well clayed, and lie lower by 3 or 4 Foot than the Bottom of the Aqueduct, which brings the Water in for the Purposes before mentioned.

If the Reservoir be but small, as 15 or 20 Foot over, Mr. *Switzer* advises to make it in the Form of a Conoid; because by this Shape, the Pressure of the Water on the Pipe of Conduct will be regular and uniform from the Beginning to the End of the going out of the Water.

It is by this conoidal Form, that *Archimedes* in some Propositions in his two Books, *De insidentibus Humido*, demonstrates the Gravitation or Pressure of Fluids one upon another, which was also followed by *Galileo*, *Torricelli*, and others.

To the same Purpose also, *Mariotte* in his Rules for the measuring of spouting Waters, through Ajutages of different Bores, in his Treatise of *Hydrostaticks*, sets down a very curious Problem. This Problem is to find a Vessel of such a Figure, that being pierced at the Bottom with a small Hole, when the Vessel is small, but larger as a Vessel or Reservoir is larger, that the Water should go out, its upper Surface descending from equal Heights, in equal Times. This he says, *Torricelli* has not undertaken to resolve.

Let it be a conoidal Figure, as *Fig.* 1. in the following Plate, where B L is to B N, as the Square squared of N O, and B N to B H, as the Square squared of N O, to the Square squared of H K, and so on: the Water will descend from A D C, in an uniform manner, till it come to the Hole at B.

For let B P be the Mean Proportional betwixt B D and B H since the Square squared of K H and of D C are to each other, as the Heights B H, B D, the Squares of H K, D C will be in a subduplicate Ratio of B H to B D, or as the Heights B P, B D.

But the Velocity of the Water that goes out at B, by reason of the Pressure of the Height B H in a subduplicate Ratio of B D to B H; that is to say, as B P to B D: Therefore the Velocity of the Water descending from H, is to the Velocity of the Water descending from D, as the Square of H K to the Square of D C: but the circular Surface of Water at H, is to the circular Surface of the Water at D, as the Square of H K to the Square of D C; therefore they will descend and run out, one as fast as the other: and if the Surface A D C runs out in a second, the Surface G H K will run out in a second likewise, since the Quantities are as the Velocities.

The same Thing will happen to the other Surfaces at E and F, &c. But the Hole must in

all minute Cases causes be very small, and that no considerable Acceleration may be made, and that the Water may not go throughout the Hole sensibly; but in a Proportion to the Weight.

A Vessel of this Model, says the ingenious M. *Mariotte*, may serve for a *Clepsydra*, or Water Clock.

To this it may be added, saith an Ingenious Author, For any Reservoir for supplying and playing Fountains, or any other Water Works, in Gardens, or for the regular Distribution of Water for the Use of any City or Town, and as still the more useful, and proper to be made, when the Spring rises near the Place where the Water is to be used, as does that of *Long-Leat* in *Wiltshire*, the Seat of the Right Honourable the Lord Viscount *Weymouth*, and other Places.

The Section or Profile of a Reservoir being thus set down, pertaining as it does only to those which are narrow and deep, as all Reservoirs must be, which are made on the Side of a Hill, and near a Spring, it will be requisite to inform the Reader, that the Structure of such Reservoir or Cistern be of Stone or Brick, since there is no working of Clay, to stand in so perpendicular a Manner, as the Figure describes.

But when Reservoirs are made of that great Extent, which they often are, this Profile or Section can be of no great use, nor can the Figure of it be followed.

I shall therefore lay down a short Account of those Rules that are necessary to be observed in the Profile and Disposition of Reservoirs, that are made of Clay, and the Methods of digging, picking, cleansing, beating or ramming of that useful Material.

The Steps then on each Side, and on the Ends of any Reservoir, if the same be made of Clay, which is the cheapest Material by much, with which Reservoirs or Ponds are usually made, ought to be at least 3 Foot horizontal to one Foot perpendicular, that they may stand well, and not be apt to moulder: so that if a Reservoir be made 7 or 8 Foot deep, which ought to be done in Works of this Kind, the Basis of the Slope ought to be 28, 30 or 32 Feet; the Profile or Section of which see *Fig.* 2. and the Banks ought to be cleared of all Trees and other Incumberances which are apt to tear the Banks by their Rocking, by reason of the blowing of Winds.

The most proper Season for digging of Clay, and making Reservoirs, and other Waterworks of this kind, is generally reckoned to be about *Michaelmas*, after the Falling of the first Rains; for then the Clay will work well; and the cool Season is coming on, and in such Manner, that you may expect the Rains will fill your Work, in case a Supply should be precarious.

But the Winter or Spring, or indeed any other Part of the Year will do as well, provided the

the Clay be uſed immediately after it has been digged; and that you have a River, a ſtrong Spring, or ſome good Engine to fill it; but you muſt be ſure to avoid Froſts, and the dry cutting Winds of *March*, which are more injurious to new Ponds, than any other Variation or Change of Weather does.

When the Shape of the Reſervoir or Pond has been made, then the Clay is to be dug, and immediately uſed, otherwiſe you will be obliged to water it, which will ſpoil it; alſo all large Stones, Sand Holes, and Veins ſhould be carefully picked out; and all ſuch Parts as any way degenerate from the general Maſs or Vein of the Clay that is digged, ſhould be thrown out.

The ſtrong reddiſh or yellowiſh Clays are accounted the beſt, tho' there are alſo white and blue Clays, which are as tenacious as any of the reſt; tho' perhaps they are not ſo ductile, and do not work ſo well.

The Pond-men in the Weſt-country chuſe that Sort of Clay that has ſome ſmall Quantities of ſmall Pebbles or Gravel in it, becauſe they ſay it rams better; there is alſo this Conveniency in them, that they lying upon the Chalk, will contract the Sediment and Slime, which comes with the Water, and render it more pure and clear.

Clays often run in Veins; but if it be dug out of Pits, where it lies deep; generally the deeper you go, the better and ſtronger the Clay is.

Having found and dug a good Clay, carry it to the Place where it is to be uſed, and uſe it immediately, before it has been hardened by the Sun and Air, ſo that it won't work; but if you have not immediate Occaſion for it, cover it with long moiſt Horſe-dung, or wet Hay or Thatch, and when it has been brought to the Place, where it is to be uſed, begin in the very Centre or Middle of the Bottom of the Pond, where it muſt be laid thicker than ordinary; and then you muſt work every Way from it, treading and beating it well with Inſtruments, as you proceed: As to the Thickneſs of the Layer of Clay, there is no certain one agreed upon; ſome laying it a Foot, others a Foot and a half, and ſome thicker; and they lay it not all at once, but in two diſtinct Layers of about 6 or 8 Inches thick.

Having begun (as has been directed in the very Centre or Middle of the Reſervoir, and laid it there about 6 or 8 Inches thick; the Horſe-heads or large Spits of Clay may be thrown together, juſt as they are dug out of the Pit, only picking out the large Stones, or any Veins of Sand that are in it, and work it well together with a large heavy Beater or Beetle, ſuch an one as is uſed in cleaving of Wood.

Finiſh a Yard or two at a Time in this Manner; which being done, you muſt uſe another Flat Beater, ſuch as Greeſe, is

is beaten with; or rather (which is better) have one made in the Form of a hard Bruſh, wherewith Maid-Servants rub their Rooms: but the Handle of it muſt be ſtronger, and in the Block there ſhould be fix'd, 4, 5 or 6 ſtrong Iron Teeth; which will cut or ſcratch croſs the Joints, and prevent any open Chaſm or Crack that would otherwiſe be there.

When this has been done, take ſuch a Rammer as is us'd by Paviours (tho' it need not be quite ſo heavy) and ſmooth it over.

After you have done this, it will be proper to lay a little long Dung, Hay or Thatch on it, to keep the Clay from cracking till you lay on the ſecond Coat.

Having thus finiſh'd the firſt Coat, after the Manner before directed, ſtrew ſome ſlak'd Lime over it; which will not only corroborate and cauſe the Clay to grow hard and dry, and as it were, almoſt impenetrable; but it will alſo (as the Weſt-Country Pond-makers ſay) hinder the Worms from working into the Clay.

Thus having finiſh'd the firſt Coat or Layer of Clay; begin the ſecond of the ſame Thickneſs as you did the firſt, working it after the ſame Manner, every way from the Centre, taking Care eſpecially to break, join or cloſe the Clay well, by Means of your toothed or ſpiked Inſtrument beforementioned; and there will be this Advantage in doing it over again, that if there ſhould be the leaſt Crack or Perforation in the firſt Layer, the ſecond coming over it, will fill it up, and mend every Place that may have happen'd to be defective.

Having finiſh'd the ſecond Coat, as before, mix ſome Lime and Chalk together, and ram it on three or four Inches thick, which incorporating into the Clay, will render it as it were one ſolid Body, which, if there be Occaſion, may be pitch'd with Flint Stones; that is, if Cattle are allow'd to go to it to drink.

All Reſervoirs, if not wharf'd with Wood, Brick or Stone, (which is very expenſive) ought to be pitched a Foot or two below the High-Water Mark, to prevent the Clay from being waſh'd away on the Sides of the Reſervoir; as alſo the working of Moles, Mice and other Vermin who ſpoil the Banks.

Some will lay a third Layer or Coat of Clay over the other two, and of the ſame Thickneſs, *viz.* ſix or eight Inches: This Method is not to be diſapprov'd of (if Perſons are willing to be at the Expence) and is alſo neceſſary in Grounds that are of a dry, gravelly, huſky Nature; one of which Kind in *Eſſex*, the Water ran out ſo faſt till the Earth was ſated, that an Engine which was employ'd three Days and Nights could ſcarce keep it full; ſo that three times Claying is not much more expenſive, but is very much ſecurer.

The digging and claying of a Reſervoir or Canal twice, is

ſaid to be worth 12*d.* a Yard ſuperficial; and if it were to be clay'd a third time, it would not be above 3*d.* a Yard more, but then all the Clay muſt be brought to the Place; but ſome Head Weſt Country Pond-men have had 18*d.* *per* Yard for twice claying.

It has been obſerv'd that the Pond-men in the Weſt of *England*, do not pitch their Fiſh-Ponds ſo much as they were won't to do; but lay Chalk upon the Clay, ſix or eight Inches thick; which is better than pitching for all Sorts of Fiſh.

WATER WHEEL, an Engine for raiſing *Water* in great Quantity out of a deep *Well.*

It is of different Makes; ſome uſe a large one for Man or Beaſt to walk in for that Purpoſe, others a double Wheel with Logs, which makes it draw eaſier than the ordinary ſingle Wheel; tho' this is not ſo good a way as the double Wheel with Lines; the Line at the Hand being ſmall and very long: but there cannot be a more expeditious way than to make a larger Wheel at the End of the *Windlaſs*, that may be two or three times the Diameter of the *Windlaſs*, on which a ſmaller or a larger Rope may be wound, than that which raiſes the Bucket; ſo that when the Bucket is in the Well, the ſame Rope is all of it wound on the greater Wheel, the End of which may be taken on the Shoulder, and the Man may walk or run forwards, till the Bucket is drawn up; in which Operation the Bucket may hold 20 or 30 Gallons, and yet be drawn up with more Eaſe than one of ſeven or eight in the ordinary way; and beſides the Bucket may have a round Hole in the Bottom, with a Cover fitted to it like the Sucker of a Pump, that when the Bucket reſts on the Water, the Hole may open and the Bucket fill, and as ſoon as it is rais'd, the Cover ſtops it immediately, which prevents it from diving.

Teeth may alſo be made on the outer Wheel, with a wooden Ledge, ſo falling upon it, that as the Man moves forward, it may ſtop; but when the Bucket is as high as is intended, then the Ledge bearing againſt the Teeth, ſtops the Bucket until you come to it, after the Manner of the Wheel of a *Watch*, *Clock* or *Jack*.

To which may be added, that when the Bucket is up, a Receiver may be at Hand, and a moveable Trough to ſlip under the Bucket; that when the Cover is rais'd by a ſmall Cord, faſtened to it on the Inſide, the Water may be receiv'd thereby: by this Means many Tuns of Water may be drawn up in a ſhort Time.

WEATHER BOARDING [in *Carpentry*] ſignifies the nailing up of Boards againſt a Wall.

Sometimes 'tis us'd to ſignify the Boards themſelves, when nail'd up.

This Work is uſually done with Feather-edg'd Boards: In plain Work they uſually nail the

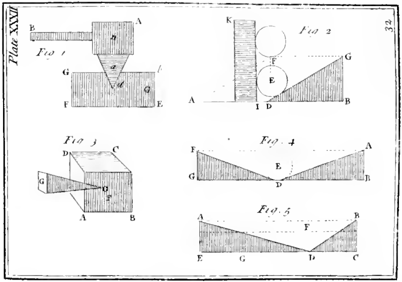
Plate XXVII
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Fig 1
Fig 2
Fig 3
Fig. 4
Fig. 5

the thick Edge of one Board, an Inch or an Inch and a half over the thin Edge of another; but if the Work is to be something extraordinary; they set an O G on the thick Edge of every Board.

The Price] The Price of *Plain Weather Boarding (viz.* the fitting and nailing up the Boards) is from 8 *d.* to 12 *d.* the Square, according to the Length and Breadth of the Boards, and Conveniency of the Place.

But if the lower, *(viz.* the thicker) Edge of the Boards be wrought with an O G it may be worth 18 *d. per* Square, for the Workmanship only.

If the Workman find the Materials *(i.e.* Boards and Nails*)* it may be worth 12 or 13 *s. per* Square, or about 1 *d.* ½ *per* Foot.

WEATHER TILEING is the covering the upright Sides of Houses with Tiles.

The Price.] *Weather Tileing* is done in some Places at the same Price as other *Plain Tileing*; but in other Places they have more in Consideration of Scaffolding: for some Workmen say they have 4 *s. per* Square for Workmanship only.

WEDGE. The Power of this Engine is put in Motion by Percussion or striking; it is therefore to be first observ'd That the Centre of Percussion is that Point by which a Body, as a Beetle, &c. in its Motion strikes with its greater Force another Body (as a Wedge*)* which opposes its Motion.

That is, the Point A in the middle of the Wedge A D, just under the Centre of Gravity N, of the Beetle B A is the Centre of Percussion, and the Line N A is its Line of Direction. See *Plate, Fig.* 1.

And it is to be observ'd here, as before, in the preceeding Machines, that the greatest Force or Blow is given, when it falls perpendicularly upon the Wedge; on which the Stroke or Force is apply'd; for 'tis evident, that if the Stroke or Force is applied at oblique Angles, as the Beetle E F, the Line of Direction of the Force N B, will not be parallel to the Central Line of the Wedge A I; nor will the Line of Direction of the Force E N, be parallel to the upper Surface of the Wedge, as in the former.

Now, seeing that the Line of Direction N B is contrary to the Line of Direction N A D, 'tis evident that the Beetle F E apply'd at oblique Angles, has less Force on the Wedge I, than when apply'd at Right Angles, as the Beetle B A on the Wedge C.

To understand the Power of the Wedge, one of the inclining Sides is to be considered as a horizontal Plain, and we must imagine, that by the Help of the inclin'd Surface, a Power shall raise a Weight, which without this Machine, could not so much as sustain or bear it up.

1. Let the Triangle D B C, right-angled at B, represent a Wedge, wherein let the angular Point D, represent the Point or Edge, and the Perpendicular

 B C.

BC, the Head at which the Power is to be apply'd.

For the better underſtanding the Power of this Engine, the Length of its Baſe, as DB, and Height BC muſt be given or known, that thereby their Proportions to one another, may be known. See *Plate*, *Fig.* 2.

For the Analogy or Proportion is this:

As the Height of the Wedge
Is to the Baſe of the Wedge,
So is the Power apply'd at its Centre of Percuſſion, to the Weight that the Wedge will ſuſtain or bear up.

Which will immediately be demonſtrated; but 'tis to be noted, that in all Calculations of this Kind, the Surfaces of the horizontal Plane, whereon the Wedge ſlides, the Surfaces of the Wedge, the Surface of the Body to be rais'd, are ſuppos'd to be ſo very ſmooth, as to ſlide without Obſtrúction or Difficulty.

Again it muſt alſo be ſuppos'd, that the Weight E be hindred from going to A, by the perpendicular Plane HIK; which however is to be ſuppos'd not to hinder the Wedge DCB from ſliding along the horizontal Plane A B, as 'tis driven or forc'd from B towards the Power apply'd at B, whoſe Line of Direction is parallel to the Horizon.

Now if the Power apply'd at B, drives or forces the Wedge CDB regularly from B towards A, upon the horizontal Plane A B, it will cauſe the Weight E to aſcend by ſo regular a Motion, that its Centre of Gravity E will by its Aſcenſion generate the Right-Line F D, perpendicular to the Horizon; ſo that when the Point B ſhall be come to D, the Point C to E, and the Point D to G, the whole Wedge C D B ſhall have chang'd its Place to E D G, and the Body E will be rais'd the whole Height of C B, the perpendicular Height of the Wedge.

Now if B B the Baſe, be = twice B C the Height, then the Power ſhall have mov'd the Line D B its whole Length, which is = twice C B, and therefore the Power to the Weight will be, as 1 is to 2: That is,

As the Height CB 1,
Is to the Baſe D B 2:
So is the Power of one Pound apply'd by Percuſſion at B, to two Pound, the Weight of the Body E, rais'd to F.

From hence it follows, that the more acute the Wedge is, the greater will its Effect be: becauſe G D the Velocity of the Power, will be great in Compariſon of DF, the Velocity of the Weight.

When the Wedge is apply'd to cleave a Body, as A B C D, the Planes E F O I and GFOH, which make up the Wedge, being more inclin'd to each other, the Parts E G will therefore ſlide more eaſily.

If the Plane E F O I be conſidered as a horizontal Plane, the other Plane G F O H will be an inclining Plane; wherefore the Reſiſtance of the upper Part of the Body A B D C, which is to be diſunited from the lower, may be accounted as a Weight whoſe Line of Direction

rection is perpendicular to the lower or horizontal Part, and then a Power apply'd as aforesaid with an additional Power for the Roughness of the Body, when irregular will have the Effect desired. See *Plate*, *Fig.* 4.

It is also to be observ'd, that altho' the Power of a Blow or Stroke, is equal to a certain Weight, yet if that Weight is laid gently upon a Wedge, it will not have the same Effect in forcing it into a hard Body, as when the same Weight is communicated to it by a Blow.

And it is also to be observ'd, that the Effect of Percussion will be the greater in Proportion as the Percutient or striking Body is heavier and swifter: that is to say, the heavier the Body is, with which the Stroke is given, the greater Effect it will have.

Therefore,

If with a Body of ten Pound Weight, a Stroke be given in one Second of Time, that will raise 20 Pound Weight, the same Body being struck in like Manner, will double the Force; that is, in half a Second of Time, it will raise 40 Pound Weight, which is double to the former.

Hence it appears, that the Power of Percussion is proportionable to the Velocity of the Stroke.

If any shall object that they do not conceive how the Wedge is of any great Use in raising heavy Bodies, since there seems to be a resisting Plane necessary as K H I, which in many Cases cannot be practicable, and therefore of Consequence, the Wedge seems to be of little Use.

But such Persons are mistaken; for an heavy Body may be rais'd without a Plane perpendicular to resist it.

As for Example, Suppose the Body E is to be rais'd to the Height of the Wedge F G, it is plain that if against the Wedge F D G, you place another Wedge, as A B D equal thereto, so as to work close to each others Sides, and each Wedge being driven with equal Force, will raise the Body E the Height required. See *Plate*, *Fig.* 4.

And as has been said before, the longer or more acute the Angle of the Wedge is, the easier the Weight will be rais'd. This has been already prov'd, and therefore I shall not repeat it.

It is likewise to be observ'd in this, as has been observ'd of other Mechanical Powers; that as much as is gain'd in Force, is lost in Space and Time, because the more acute a Wedge is made, the greater Length it must be to be equal in Height to another Wedge, whose Angle is less acute, or rather, whose Angle contains a greater Number of Degrees.

That is, the Wedge A C D, whose Line A D C is less than the Line B D E, must be longer than the Wedge B D E, to be equal in Height thereto, for was the Wedge A D C to be no longer than the Wedge B D E, that is, G F D E, then it could

not raiſe the Body higher than F. See *Plate*, *Fig.* 5.

Hence 'tis evident that D F muſt be continued to A, and D G to C, whereby it will raiſe the Body to the Height requir'd.

And ſince that tho' the Wedge ADC will move with leſs Force than the Wedge B D E, yet it requires more time, becauſe its Length C D is greater than D E.

Therefore it is plain, that what is got in Force, is loſt in Space, as has been already prov'd in other Engines.

WEIGHT is a Quality in natural Bodies, whereby they tend downwards, towards the Centre of the Earth.

Or *Weight* may be defin'd to be a Power inherent in all Bodies, whereby they tend to ſome common Point, call'd the Centre of *Weight* or *Gravity*; and that with a greater or leſs Velocity, as they are more or leſs *denſe*, or as the Medium they paſs thro' is more or leſs rare.

But there may yet be another Definition. As in Effect one may conceive *Gravity* to be the *Quality*, as inherent in the Body; and *Weight* the ſame Quality exerting it ſelf, either againſt an Obſtacle or otherwiſe.

Hence Weight may be diſtinguiſh'd like Gravity into *abſolute* and *ſpecifick*.

Sir *I. Newton* demonſtrates, that the *Weights* of all Bodies, at equal Diſtances from the Centre of the Earth, are proportionable to the Quantity of Matter that each contains.

Whence it follows, that the Weights of Bodies have not any Dependance on their Forms or Textures; and that all Spaces are not equally full of Matter.

Hence it follows, that the *Weights* of the ſame Body, is different on the Surface of different Parts of the Earth; by Reaſon that its Figure is not a Sphere, but a Spheroid.

The Law of this Difference the Author gives in the following Theorem.—The Increaſe of Weight as you proceed from the Equator to the Poles, is nearly of the verſed Sine of double the Latitude; or which amounts to the ſame: as the Square of the Right Sine of the Latitude.

WEIGHT [in *Mechanicks*] is any Thing that is to be rais'd ſuſtain'd or mov'd by a Machine; or any Thing that in any Manner reſiſts the Motion to be produc'd.

In all Machines there is a natural Ratio between the *Weight* and the moving Power. — If the Weight be increas'd, ſo muſt the Power too; that is, the Wheels, &c. are to be multiply'd, and ſo the Time increas'd, or the Velocity diminiſh'd.

WELDING *Heat* [in *Smithery*] a Degree of Heat which Smiths give their Iron in the Forge; when there is Occaſion to double up the Iron, and to weld a work in the doublings; ſo that the Iron ſhall grow into a Lump, thick enough for the Purpoſe.

WELL [in *Building*] is a Hole

Hole left in the Floor for the Stairs to come up thro'.

WELL, a narrow Opening of a cylindrical Form, made by digging in the Earth: Wells where they are not natural, are principally made, in order to have Water in thofe Places where it is wanted.

In digging for a Well, you muft do it in a Place remote from Houfes of Offices, Stables, Dunghils, and other Places, which by their Stench may impart a very difagreeable Tafte to the Water: as for the Goodnefs of the Water, that depends upon the Nature of the Place where the Well is digged; for if the Earth be fandy or black, or inclines to a Potters Clay, and white, flimy Soil, or to fpeak more properly, if it has Flint and Sand together, then there is no doubt to be made but that the Water will be very good.

On the contrary, if it be fpungy, or has Chalk or Mud therein, it will not anfwer the Purpofe; and happy are they who have Grounds endued with thofe Qualities that are neceffary for yielding good Water; otherwife there is no Remedy.

There are feveral Perfons who have Houfes near Meadows, and have a mind to dig for Wells, believing they may fave Money by making them in fuch Places, and obferving thofe where Willows are planted, or elfe, where Reeds grow, whofe Nature has an entire Tendency to Moifture; they fix their Plan immediately there, and fancy a Well dug at fuch a Place and with a fmall Expence, cannot but be lafting; but they are much miftaken, for tho' thefe Places are very moift, yet the Wells that are made there, are much more fubject to dry up than others; and the Water is generally good for nothing.

Wells muft be always kept in Repair, the Labour is not great; and no further Care is to be had, than to cleanfe them once a Year, and that no Filth of any Kind be thrown into them.

But in Oppofition to the Opinion of thofe who keep their Well covered in order to preferve them clean, it may be affirm'd, that they cannot be kept too open, that the Air may have a free Paffage, which fubtilizes the Nature of the Water, and makes it much purer than otherwife it would be without this Help.

If you would drink good Well Water, you muft draw it often; for it is moft certain, that the oftener Water is drawn, the lefs grofs the Parts will be that compofe it; and confequently it will be more conducive to your Health.

If you would have Wells near the Sea, with frefh Water, dig a good large Ditch or Pit, as of about 100 Foot Diameter; having firft planted very long Stakes or Piles, cleanfe it well, throw out the Mud; befides thefe Stakes, by the Help of which you defend it againft the Tide; and when the Pit is dry, and that there is no wet in it,

are to fix another Row of very long Piles, about ten Foot diſtant from the firſt, and likewiſe throw out the Mud, and this ſhould be done three or four times, till you come at freſh Water.

When by any of the before-mention'd Trials in the Article *Water*, a Place has been pitch'd upon that is proper to bore, you muſt provide your ſelf with a large Augar, that may be grafted at every five or ſix Foot; and having made a Hole in the Top of the Ground, where yon intend to bore, about three or four Foot wide, or more, to give Room for the Workmen to make the Experiment the better, then you may proceed; and when you have bor'd one Length of the Augar of four or five Foot, as aforeſaid, then graft on another Length, and ſo on, till you come down to the Water, ever and anon pulling out your Augar and cleanſing it, to examine what Soil you bore through.

When you dig for a Well, great Care ought to be taken, not only in ſtewing the Sides, to keep the Earth from falling in npon the Workmen; but to take Care that the Effluvias of the Water (which if bad) do not hurt them; for it has been often found, that the Water which is under the Earth, hath many bad Qualities, and emits Vapours, which ofren ſtifle thoſe that work in the Well after it has been dug.

To prevent which, the Ancients (as *Vitruvius* has it) were wont to let a Lamp gently down into it, and if it extinguiſh'd it. they took it for an infallible Sign that the Water was bad.

WHEEL [in *Mechanicks*] is a ſimple Machine, conſiſting of a round Piece of Wood, Metal or other Matter; turning round on an Axis.

The *Wheel* is one of the principal *Mechanick* Powers, it has Place in moſt Engines; and indeed 'tis of an Aſſemblage of *Wheels* that moſt of our chief Machines are compos'd, as Mills, *&c.*

Its Form is various, according to the Motion it is to have, and the Uſe it is to anſwer, and is accordingly diſtinguiſh'd into *ſimple* and *dented*.

Simple Wheels are ſuch whoſe Circumference and Axis is uniform, and which are us'd ſingly, and without a Combination.

Such are the *Wheels* of Carriages which are to have a double Motion; the one circular about their Axis; and the other rectilineal; by which they advance along the Road, *&c.* which two Motions they appear to have, tho' in Reality they have but one; it being impoſſible that the ſame Thing ſhould move or be agitated two different ways at the ſame time.

This one is a ſpiral Motion, as is eaſily ſeen by fixing a Piece of Chalk on the Face of a *Wheel*, ſo as it may draw a Line on a Wall, as the *Wheel* moves.

The Line it here traces, is a juſt

just Spiral, and ſtill the more curve as the Chalk is fix'd nearer the Axis.

In Wheels of this Kind, the Height ought to be always proportioned to the Nature of the Animal that draws or moves them.

The Rule is, that the Axis and Load of the Wheel be of the ſame Height, with the Force that moves them; or elſe the Axis being higher than the Beaſt, Part of the Load will lie on him; or if it be lower, he will pull at a Diſadvantage, and muſt exert a greater Force.

Dr. *Wallis* and others have ſhewn, that to draw a Vehicle, *&c.* over waſte uneven Places, it will be beſt to fix the Traces to the Wheels lower than the Horſe's Breaſt.

The Power of theſe Wheels reſults from the Difference of the Radii of the Axis and Circumference.

The Canon is this: As the Radius of the Axis is to that of the Circumference, ſo is any Power to the Weight it can ſuſtain hereby.

This is alſo the Rule in the Axis in *Peritrochio*; and the Wheel and the Axis in *Peritrochio*, See *Plate, Fig. 6.* are in effect, the ſame Thing; only in Theory it is uſually called by the former Name, and in Practice by the latter.

Dented Wheels are thoſe whoſe Circumference, or elſe Axis, is cut in Teeth, by which they are rendred capable of moving and acting one on another, and of being combined together.

The Power of dented Wheels depends on the ſame Principle, as that of the ſimple one. The Difference is only that to the ſimple Axis in *Peritrochio*, which a compound Lever is to a ſimple one.

Its Doctrine is compriſed in the following Canon, *viz. The* Ratio *of the Power to the Weight, in order for that to be equivalent to this, muſt be a* Ratio *compounded of the* Ratios *of the Diameter of the Axis of the laſt Wheel, to the Diameter of the firſt, and of the* Ratio *of the Revolutions of the laſt Wheel, to thoſe of the firſt in the ſame Time.*

But this Doctrine will deſerve a more particular Explication.

1. Then if the Weight be multipled into the Product of the *Radii* of the Axis, and that Product be divided by the Product of the *Radii* of the Wheels, the Power required to ſuſtain the Weight will be found.

2. If the Power be multiplied into the Product of the *Radii* of the Wheels, and the *Factum* be divided by the Product of the *Radii* of the Axis; the Quotient will be the Weight which the Power is able to ſuſtain: thus if the Power be $22\frac{1}{3}$ of a Pound, the Weight will be 6000 Pounds.

3. *A Power and a Weight being given to find the Number of Wheels, and in each Wheel, the* Ratio *of the Radius of the Axis to the Radius of the Wheel: So as that the Power being applied perpendicularly to the Periphery of the laſt Wheel,*

Wheel, may ſuſtain the given Weight.

Divide the Weight by the Power: Reſolve the Quotient into the *Factors* which produce it, then will the Number of *Factors* be the Number of *Wheels*; and the *Radii* of the Axis will be to the *Radii* of the *Wheels*, as *Unity* is to the ſeveral *Wheels*.

As ſuppoſe for Example, a Weight of 3000 Pound, and a Power of 60, which reſolves into theſe *Factors* 4,555 Four Wheels are to be made, in one of which the Radius of the Axis is to the Radius of the Wheel, as 1 to 4. In the reſt, as 1 to 5.

4. If a Power move a Weight by the means of two Wheels, the Revolutions of the ſlower Wheel, are to thoſe of the ſwifter, as the Periphery of the ſwifter Axis is to the Periphery of the Wheel which catches on it.

5. If a Power move a Weight by means of divers Wheels, the Space paſs'd over by the Weight is to the Space of the Power, as the Power is to the Weight. Hence it follows, that the greater the Power is, the faſter will the Weight be moved, and *vice verſa.*

6. The Spaces paſs'd over by the Weight and the Power, are in a *Ratio* compounded of the Revolutions of the ſloweſt Wheel, to the Revolutions of the ſwifteſt; and of the Periphery of the Axis of that, to the Periphery of this.

Hence, ſince the Space of the Weight and the Power, are reciprocally as the ſuſtaining Power to the Weight; the Power that ſuſtains a Weight, will be to the Weight, in a *Ratio* compounded of the Revolutions of the ſloweſt Wheel, to thoſe of the ſwifteſt, and of the Periphery of the Axis of that, to the Periphery of this.

7. *The Periphery of the Axis of the ſloweſt Wheel, with the Periphery of the ſwifteſt Wheel given; as alſo the* Ratio *of the Revolution of the one to thoſe of the other, to find the Space which the Power is to paſs over, while the Weight goes any given Length.*

Multiply the Periphery of the Axis of the ſloweſt Wheel into the antecedent Term of the *Ratio*, and the Periphery of the ſwifteſt Wheel into the conſequent Term; and to theſe two Products, and the given Space of the Weight, find a fourth Proportional: This will be the Space of the Power.

Suppoſe, for Example, the *Ratio* of the Revolutions of the ſloweſt Wheel, to theſe of the ſwifteſt, to be as 2 to 7; and the Space of the Weight 30 Feet: and let the Periphery of the Axis of the ſloweſt Wheel be to that of the ſwifteſt, as 3 to 8, the Space of the Power will be found to be 280.

8. *The Ratio of the Peripheries of the ſwifteſt Wheel, and of the Axis of the ſloweſt; together with the* Ratio *of their Revolutions, and the Weight being given, to find the Power able to ſuſtain it.*

Multiply both the Antecedents and the Conſequents of the given Ratio into each other, and

and to the Product of the Antecedents, the Product of the Consequents, and the given Weight, find a fourth Proportional, and that will be the Power required.

As suppose, for Example, the *Ratio* of the Peripheries 8 : 13 that of the Revolutions 7 : 2, and the Weight 2000, the Power will be found 214 $\frac{2}{7}$. After the same Manner may the Weight be found; the Power and the *Ratio* of the Peripheries, &c. being given.

9. *The Revolutions the swiftest Wheel is to perform, while the slowest makes one Revolution, being given; together with the Space, the Weight which is to be rais'd, and the Periphery of the slowest Wheel; to find the Time that will be spent in raising it.*

Say, as the Periphery of the Axis of the slowest Wheel is to the Space of the Weight given; so is the given Number of Revolutions of the swiftest Wheel to a fourth Proportional, which will be the Number of Revolutions performed, while the Weight reaches the given Height.

Then by Experiment determine the Number of Revolutions the swiftest Wheel performs in an Hour; and by this divide the fourth Proportional found before, the Quotient will be the Time spent in raising the Weight.

The Power of the Wheel by its Axle.

This Engine is of great use at the several Keys and Wharfs of *London*, in raising and taking up all manner of Goods of Burden, at their Loading and Unloading in and out of Ships, &c. where the Power applied is the Weight of Men who walk within the Wheel, and thereby raise the Weight required. See *Plate*, *Fig.* 4.

If you observe this Machine, and consider the Radius A O of the Wheel A B C D, with the Radius O G of the Axis, which move on their Centre O, it is plain, that it is nothing but a *Lever* of the first kind perpetually turned round; for A O is the Distance of the Power, O G, the Distance of the Weight, and the Centre O the *Fulcrum*. And therefore,

If a Weight is raised by Means of such a Wheel, with its Axle moving round its Centre, by a Power whose Line of Direction touches the Circumference of the said Wheel, the Power will be to the Weight, as the Radius of the Axle is to the Radius of the Wheel.

Suppose the Weight E in the Figure is raised by means of the Wheel A B C D, with its Axle E O G moving round the Centre O, by a Power Z, whose Line of Direction Z A touches the Circumference of the Wheel, as a Tangent raised from the Point A of the Radius A O; the Power A will be to the Weight I, as the Radius of the Wheel A O, is to the Radius O G of the Axle.

Let the Radius A O be = 10 Feet, the Radius O G = 1 Foot, and the Power applied at

A

A = 15 Pound Averdupois; then I say,

As the Radius of the Axle 1 Foot,

Is to the Radius of the Wheel 10 Feet,

So is 15 the Power applied to 150, the Weight at I, which is the Equipoiſe of the Power A required.

Again the Weight being given to find the Power.

As the Radius of the Wheel 10 Feet,

Is to the Radius of the Axle 1 Foot,

So is 150 the Weight given, to 15 the Power required.

The OPERATIONS.

1 : 10 :: 15 : 150	10 : 1 : 150 : 15
10	1
1)150(150	10)150(15

From theſe Operations, 'tis plain, that as much as the Radius of the Wheel is greater than the Radius of the Axle, ſo much is the Power of the Force increaſed, always ſuppoſing the Line of Direction of the Power to touch the Circumference of the Wheel, as A Z, whereby the Line O A Z will always be the ſame, and a right Angle to whatever Point of the Circumference is applied; for were the Line of Direction otherwiſe applied, this would not hold. As for Inſtance.

Suppoſe the Power were applied at L, and its Line of Direction L K perpendicular to Horizon, then it is evident, that the Diſtance of the Power from the *Fulcrum*, would be but = K O; and ſince that K O is leſs than A O, it is plain that the Power is thereby diminiſhed, and made leſs than when applied at A as aforeſaid.

It being thus demonſtrated, that the Power of the Wheel and Axle is gain'd by the Difference of their reſpective Radius, it appears to be with this as with the other mechanical Powers, that whatever is gained in Force, is loſt in Time and Space.

This is very eaſily underſtood; for as the Radius of the Axle makes but one Revolution in the ſame Time that the Radius of the Wheel makes one Revolution, 'tis evident, that the Circumference of the Wheel, which is greater than the Circumference of the Axle, muſt move with greater Force, and that proportionably to the Difference of their Radius.

In this Example, the Circumference of the Axle is = $3\frac{3}{20}$ nearly, and the Circumference of the Wheel = $31\frac{1}{2}$ nearly.

Now, if $31\frac{1}{2}$ be divided by $3\frac{3}{20}$ nearly, the Quotient is = 10; that is, the Circumference of the Axle is contained 10 Times in the Circumference of

the

the Wheel; wherefore the Wheel to raise the Weight one Foot in Height, must pass thro' a Space of 10 Feet; so that what it will have gain'd in Force, will be lost in Space, according to the Difference of the Radius, which is as 1 is to 10. Q E D.

WHISPERING Places depend on this Principle, that the Voice being applied to one End of an Arch, easily rolls to the other. Accordingly all the Contrivance of a whispering Place, is, that near the Person who whispers, there be a smooth Wall arch'd, either cylindrically or elliptically. A circular Arch will do, but not so well.

The most remarkable Places formed for the Conveyance of Whispers, are the Prison of *Dionysius* at *Syracuse*, which increases a soft Whisper to a Noise; the Clap of one's Hand, to the Sound of a Canon, *&c.*

The Aqueducts of *Claudius*, which are said to carry a Voice 16 Miles; and divers others, which *Kircher* mentions in his *Phonurgia*.

The most considerable Whispering Place in *England* is the Dome of St. *Pauls* in *London*, where the Ticking of a Watch may be heard from Side to Side, and a very easy Whisper be sent all round the Dome.

This Mr. *Derham* discovered to hold not only in the Gallery below, but above upon the Scaffold, where a Whisper would be carried over ones Head, round the Top of the Arch, tho' there is a large Opening in the Middle of it, into the upper Part of the Dome.

The famous Whispering Place in *Gloucester* Cathedral, is no other than a Gallery above the East-end of the Choir, leading from one Side of it to the other.

It consists of five Angles and six Sides, the Middlemost of which is a naked Window; yet two Whisperers hear each other at the Distance of 25 Yards.

WHITE LEAD is the Rust of Lead, or Lead dissolved by Vinegar, much used by Painters.

There are two ways of preparing it. 1. Either by reducing the Lead into thin *Laminæ*, steeping them in strong Vinegar, and every 10 Days scraping off the Rust form'd on the Surface: and repeating this till the Lead is quite consumed.

2. Or by rolling the *Laminæ* into Cylinders, like Sheets of Paper, only so as there be a little Space left between the several Folds or Turns.

These *Laminæ* are suspended in the Middle of earthen Pots, at the Bottom of which is Vinegar.

These Pots being well closed, are buried in a Dunghill for 30 Days; after which, being opened, the Lead is found as it were calcined, and reduced into what they call White Lead, to be broken into Pieces, and dried in the Sun.

White Lead is used both in Painting in Oil and Water Colours, and makes a beautiful Colour in each; but it is something dangerous both in grinding

ing

ing and uſing it, as being a rank Poiſon.

WICKET is a little Door within a Gate, or a Hole in a Door, thro' which to view what paſſes without.

WIND-BEAM. See *Collar-Beam*.

WINDLASS } is a Machine
WINDLESS } uſed for raiſing huge Weights withal, as Stones, *&c.*

It is very ſimple, conſiſting only of three Pieces of Wood, a Roll or Axle-tree, and a Pulley. The Pieces of Wood meet at Top; being placed diagonally, ſo as to prop each other. The Axis or Roller goes thro' two of the Pieces, and turns them. The Pulley is faſtened at Top where the three Pieces join.

There are two Levers go thro' the Roll, by which it is turned, and the Rope which comes over the Pulley is wound off and on the ſame.

WIND-MILL is a Kind of Mill which receives its Motion from the Impulſe of the Wind.

The Wind-mill, altho' it is a very common Machine, has nevertheleſs ſomewhat in it more ingenious than is commonly imagined.

And it is allowed to have a Degree of Perfection, which few of the popular Engines have attained to, and which the Makers themſelves are very little aware of.

The Structure of a Wind-mill.

The internal Structure of the Wind-mill is much the ſame as that of Water Mills. The Difference between them lies chiefly in an external *Apparatus* for the Application of Power. See *Plate*, *Fig.* 5.

This *Apparatus* conſiſts of an Axis, through which paſs two Rods or Yards, and interſecting each other at right Angles, whoſe Length is uſually about 32 Feet.

On theſe Rods are formed a Kind of Sails, Vanes, or Flights, in the Figure of *Trapeziums*, with parallel Baſes, the greater of which is about 6 Feet, and the leſt determined by *Radii* drawn from the Center.

Theſe Sails are to be capable of being always turned to the Wind, that they may receive its Impulſe: in order to which, there are two different Contrivances, which conſtitute the two different Kind of Wind-mills.

In the one, the whole Machine is ſuſtained upon a moveable *Arbor* or Axis, perpendicular to the Horizon, on a Stand or Foot; and turned occaſionally this way or that, by means of a Lever.

In the ether, only the Cover or Roof of the Machine, with the Axis and Sails turn round; in order to which the Cover is built Turret-wiſe, the Turret being encompaſs'd with a Wooden Ring, in which is a Groove, at the Bottom of which a Number of Braſs Truckles are placed at certain Diſtances, and within this Groove is another Ring, upon which the whole Turret ſtands.

To the moveable Ring is connected Beams, and to the

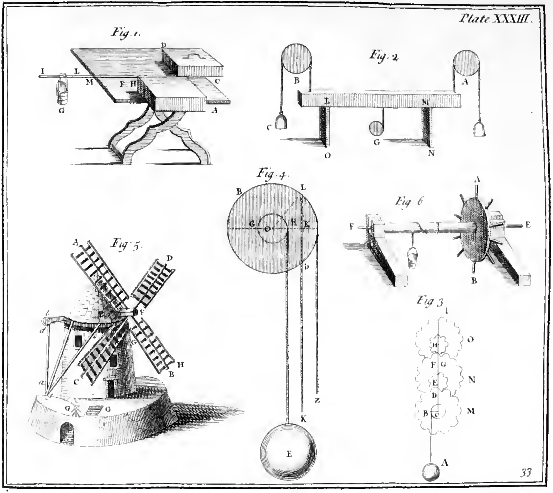
Plate XXXIII.
Fig. 1.
Fig. 2
Fig. 4.
Fig 6
Fig. 5.
Fig 3
33

Beam is fastened a Rope, which at the other Extreme of it, is fitted to a Windlass or Axis in *Peritrochio*: This Rope being drawn through an Iron-Hook, and the Windlass turn'd the Sails will be moved round, and put in the Direction required.

The Theory of the Motion of a Wind-mill, with the Position of its Vanes and Sails.

The Angle which the Sails are to make with their common Axis, so that the Wind may have the greatest Effect, is a Matter of nice Enquiry, and has employed the Thoughts of Mathematicians.

The Theory of compound Motion must be supposed in order, to conceive why a Wind-mill moves at all. A Body that moves perpendicularly against any Surface, strikes it with all its Force. If it move parallel to the Surface, it does not strike it all; and if it move obliquely, its Motion being compounded of the perpendicular and the parallel Motion, only acts on the Surface, considered as it is perpendicular, and only drives it into the Direction of the Perpendicular.

So that every oblique Direction of a Motion is the Diagonal of a Parallelogram, whose perpendicular and parallel Directions are the two Sides.

Add to this, that if a Surface which being struck obliquely, has only received the perpendicular Direction, be fastened to some other Body, so that it cannot pursue its perpendicular Direction, but must change it for some other; in that Case, the Perpendicular it self becomes the Diagonal of a new Parallelogram, one of whose Sides is the Direction, the Surface may follow, and the other, that it cannot.

Thus a Rudder fastened obliquely to the Keel of a Vessel, being struck by the Current of Water parallel to the Keel, and of Consequence obliquely with respect to it self, it will appear by drawing the Line of perpendicular Impulse, that it tends to tear the Rudder from the Keel, and to carry it away: and that this Direction perpendicular to the Rudder is oblique to the Keel.

The Rudder then would be carried off in an oblique Direction; but as in Effect it is so secured, that it cannot be torn or carried off, we are only to consider in this compound Motion, that of the two Directions, wherewith it can move without being torn from the Keel, and leave the other, which would tear it off, as useless.

Now the Direction in which it can move, without parting from the Keel, is that which carries it circularly about its Extremity, as a Centre.

So that the Effect of the oblique Impulse of the Water on the Rudder, is reduced, first to a perpendicular Impression, which is again reduced to the mere turning the Rudder round; or if the Rudder be immoveable, to the turning of the Vessel.

Now in an oblique and compound Motion, where only one of the Directions is of Service, the greater *Ratio* the other has to it, the leſs Effect will the Motion have, and *vice verſa*.

In examining the compound Motions of the Rudder, we find, that by how much the more oblique it is to the Keel, the *Ratio* of Direction which ſerves to turn it to the other, is the greater.

But on the other Hand, by how much the more oblique it is to the Keel, and conſequently to the Courſe of the Water, which is ſuppoſed parallel to it, it will ſtrike by ſo much the more weakly.

The Obliquity of the Rudder therefore has, at the ſame Time, both an Advantage and Diſadvantage; but as thoſe are not equal, and as each of them are ſtill varying, with every different Poſition of the Rudder, they become variouſly complicated; ſo that ſometimes the one prevails, and ſometimes the other.

It has been the Subject of Enquiry, to find the Poſition of the Rudder, wherein the Advantage ſhould be the greateſt. Mr. *Renau*, in his famous Theory for the working of Ships, has found, that the beſt Situation of the Rudder, is when it makes an Angle of 55 Degrees with the Keel.

If now a Wind-mill expoſed directly to the Wind, ſhould have its four Sides perpendicular to the common Axis wherein they are fitted; they would receive the Wind perpendicularly, and it is viſible that Impulſe would only tend to overturn them.

There is a Neceſſity therefore to have them oblique to the common Axis, that they may receive the Wind obliquely.

For the more eaſily conceiving, let us only conſider one vertical Sail. The oblique Impulſe of the Wind on this Sail is reducible to a perpendicular Impulſe; and that Direction, as the Sail cannot abſolutely keep to it, is compounded of two; one of which tends to make it turn on its Axis, and the other to fall backwards.

But it is only the firſt of theſe Directions can be obeyed, and conſequently the whole Impulſe of the Wind on the Sail, has no other Effect, but to make it turn from Right to Left, or from Left to Right as its acute Angle turns this way or that. And the Structure of the Machine is ſo happy, that the three other Sails are determined, from the ſame Reaſons, to move the ſame Way.

The Obliquity of the Sails with reſpect to their Axis, has exactly the ſame Advantage and Diſadvantage with the Obliquity of the Rudder to the Keel. And M. *Parent* ſeeking by the new Analyſis, the moſt advantageous Situation of the Sails on the Axis, finds it preciſely the ſame Angle of 55 Degrees; yet this Rule is very little obſerved in Practice, as, indeed, being but little known. They are uſually made about 60 Degrees, which is very much out of the way.

A

An Elliptical Wind-mill.

M. *Parent* has considered further, what Figure the Sails of a Wind-mill shall have, so as to receive the greatest Impulse of the Wind; and he determines it to be a Sector of an Ellipsis, whose Center is that of the Axis or *Arbor* of the Mill, and the little Semi-Axis the Height of 32 Feet. As for the greater, it follows necessarily, from the Rule that directs the Sail, to be inclined to the Axis 55 Degrees.

On this Foot he assumes 4 such Sails, each of which is $\frac{1}{4}$ of an Ellipsis; which he shews will receive all the Wind, and lose none, as the common ones do. These four Surfaces multiplied by the Lever with which the Wind acts on one of them, express the whole Force the Wind has to move the Machine, or the whole Force the Machine has when in Motion.

The same Manner of reasoning applied to a common Wind-mill, whose Sails are rectangular, and their Height about 5 Times their Breadth; shows that the Elliptical Wind-mill has above 7 Times the Force of the common ones, which is a prodigious Advantage; and therefore certainly deserves to have the common Practice set aside, if so common a Practice could be easily changed.

He shews, that a Wind-mill with six elliptical Sails, would still have more Force than one with four.

It would only have the same Surface with the 4; since the four contain the whole Space of the Ellipsis as well as the 6.

But the Force of the six would be more than that of the four, in the *Ratio* of 245 to 231.

If it were desired to have only two Sails, each being a Semi-ellipsis, the Surface would be still the same; but the Force would be diminished by near $\frac{1}{3}$ of that with six Sails; by reason the greatness of the Sectors would much shorten the Lever with which the Wind acts.

The best Form and Proportion of Rectangular Wind-mills.

But as elliptical Sails would be something so new, that there is little reason to expect they will come into common use; the same Author has consider'd which Form among the Rectangular ones will be the most advantageous, *i. e.* which the Product of whose Surface, by the Lever of the Wind, will be the greatest.

And by the Method, *De maximis et minimis*, he finds it very different from the common ones.

The Result of this Enquiry is, that the Width of the Rectangular Sail, should be nearly double its Height or Length, whereas the Height or Length are usually made almost five Times their Width.

Add to this, that as their Height or Length is the Dimension taken from the Centre of the Axis; the greatest Dimensions of the new Rectangular Sail, will be turned towards the Axis, and the smallest from it, which is quite contra-

ry to the Position of the common Sails.

The Force of a Wind-mill with 4 of these new Rectangular Sails, Mr. *Parent* shews, will be to the Force of 4 elliptic Sails, nearly as 13 to 24, which leaves a considerable Advantage on the Side of the elliptic ones; yet will the Force of the new Rectangular Sails be nearly 4 Times as great as those of the common ones.

M. *Parent* likewise considers what Number of the new Sails will be most advantageous, and finds that the fewer Sails, the more Surface there will be, but the less Force.

The *Ratio* of the Force of a Wind-mill with six Sails, will be to another with four, nearly as 14 to 13, and the Force of another with 2, will be to that with 4, nearly as 12 to 9.

As to the common Wind-mill, its Force still diminishes as the Breadth of the Sails is smaller, in Proportion to the Height. Therefore the usual Proportion of 5 to 1, is exceedingly disadvantageous.

The Uses of this new Theory of Wind-mills are very obvious.

The more Force a Wind-mill has, the swifter it turns, the more it dispatches, and the less Wind it needs.

To this may be added, that on this Theory, one may have a Windmill, whose Sail shall be a deal less, and yet the Force a deal greater than in the common ones.

WIND-MILL, a Mill driven or turned by the Wind, contrived for the overflowing and watering of *Land*.

Several Mills of this Kind have been used; such as the horizontal Wind-mill, which by a Wheel with Buckets, or Scoops fixed upon Chains, as also, by a Wheel carrying the Water up in Buckets, fixed thereunto, casts the same forcibly from it, by the Swiftness of it Motion.

But that is reputed the best made with vertical Sails, like the ordinary Wind-mills, only more in Number, but not so long, placed upon an Axis of a proportionable Length to the Length of the Vanes, the one End resting on a hollow moveable Piece of Timber, that will move round over the Pump as there is Occasion to turn the Vanes, the other End resting on a Semi-circle, in which are several Notches or Stays, so that it may be placed as you please, that be the Wind which way it will, by the Motion of that or the Semi-circle, you will have it at the one Side of the Vanes or the other.

Let the Pump over which one End of the Axis rests, be placed in the Pit or Well, out of which you intend to raise the Water, and the Nose or Mouth of such a Height, as you think fit to convey the Water into a Trough; which Pump may be made of what Diameter you think convenient, according to the Strength of the Wind-mill, and Height that the Water is to be raised.

The Trunk of the Pump may be made round, or if you would have it made large, then a Square may serve as well;

the

the Bucket muſt be always dipt into the Level of the Water, which prevents much Trouble and Injury to the Work.

The Handle of the Pump muſt be extended in Length, to the Axis of the Wind-mill, which muſt be made crooked to receive and move the ſame, like to the Axis of a Cutler's Grind-ſtone, or *Dutch* Spinning Wheel, turned with the Foot; or the End of the Axis of the Wind-mill may reſt on a Cylinder or Box, made moveable on the Top of the Pump itſelf, with the crooked Neck or End within the Cylinder; ſo that when you turn it any way, ſtill the End of the Axis is perpendicular over the Pump.

A Channel alſo covered or open, muſt be to convey the Water out of the River into the Pit or Well, wherein the Pump ſtands, and care muſt be taken, that the Handle or Rod of the Bucket, be ſo made, that it may, Swivel-like, turn any way, as you turn your Wind-Vanes, without twiſting or otherwiſe injuring the Bucket; which Wind-mill or Machine, by any reaſonable Gale of Wind, will raiſe a very great Quantity of Water proportionable to its Strength and Weight, with Eaſe; being made with a ſmall Charge, comparatively, and being not compoſed of very many Parts, it requires the leſs Repair, and is leſs ſubject to Damage by violent Winds. About 30 Years ago, there was a Wind-mill erected near the *New-River*, between *London* and *Iſlington*, with ſix *Wings*, being the admirable Contrivance of that ingenious Architect Mr. *Surrocole*, in order to convey Water from the lower Ponds, through Pipes under Ground, to a new one made on the Top of the Hill, conſiſting of an Acre of Ground, which ſerves ſucceſsfully to ſupply the great Increaſe of new Buildings of *London*, eſpecially to the Weſt-ward; but a ſudden Guſt of Wind, or rather a Whirle-wind, blew it down about 20 Years ago: however it was ſoon reſtored: It was alſo on the 20th of *November* 1720, blown down again, by a terrible high Wind that then happened; but the Proprietors have not thought fit to put up the Sails again, but erected another Mill near it; both which are drawn by Horſes.

WINDOWS, *q. d. Wind-doors*, are Apertures or open Places in the Side of an Houſe, to let in Air and Light.

There are various Kinds and Forms of Windows, Wire Windows, Horn Windows, &c.

Arch'd Windows, Circular Windows, Elliptical Windows, Square and Flat Windows; Round Windows, Oval Windows, Gothick Windows, Regular Windows, Ruſtick Windows, and Sky Lights.

The chief Rules in regard to Windows, are,

1. That they be as few in Number, and as moderate in Dimenſions as may conſiſt with other due reſpects; in as much as all Openings are Weakenings.

2. That they be placed at a convenient Distance from the Angles or Corners of the Building, because that Part ought not to be open and enfeebled, whose Office is to support and fasten all the rest of the Building.

3. That Care be taken that the Windows are all equal one with another in their Rank and Order; so that those on the Right Hand may answer to those on the Left, and those above be right over these below: For this Situation of Windows will not only be handsome and uniform, but also the Void being upon the Void, and the Full upon the Full, it will be a great Strengthening to the whole Fabrick.

As to their Dimensions, Care is to be taken not to give them more or less Light than is needful; that is, to make them no bigger, nor less, than is convenient; therefore regard is to be had to the Bigness of the Rooms which are to receive the Light: 'Tis evident, that a great Room needs more Light, and consequently a greater Window than a little Room, and *e contra*.

The Apertures of Windows in Middle-sized Houses, may be four and a half, or five Feet between the Jaumbs, and in greater Buildings six and a half, or seven Feet, and their Height may be double their Length at the least.

But in high Rooms, or larger Buildings, their Height may be a Third, a Fourth, or Half their Breadth more than double their Length.

These are the Proportions of the Windows for the first Story; and according to these must the upper Stories be for Breadth; but as for Height, they must diminish: The second Story may be one third Part lower than the first, and the third one fourth Part lower than the second.

As to the Price of making Windows.] Mr. *Leybourn* says, Window Frames are ordinarily agreed for by the Light; so that if a Window have four Lights, and it be double rabetted (as the Workmen call it) it may be worth 12 *s.* that is 3 *s.* a Light for Workmanship and Materials. But if the Builder find Timber and Sawing, then 1 *s.* a Light will be enough.

Transom Windows. These Mr. *Wing* says, are worth making (for great Buildings) 1 *s* 9 *d. per* Light, or 7 *s. per* Window. But some Workmen say they have 12, 14, 16 and 18 *d. per* Light.

Luthern Windows, says Mr. *Wing*; the making and setting up are valued from 9 to 14 *s* *per* Window, according to their Bigness.

Some Workmen say (if they saw the Timber) they have commonly 20 *s. per* Window.

Shop Windows. These Mr. *Leybourn* says, will be afforded at the same Rate as plain or batton'd Doors. See *Doors.*

The Price of Painting.] Mr. *Leybourn* says, the Price of Paint-

Painting is not usually measured, but valued at 3 *d.* 4 *d.* or 6 *d. per* Light, according to their Bigness, and Casements, at Three Half-pence or Two-Pence *per* Piece, and Iron Bars at a Penny more, if very large.

Windows, says M. *le Clerc*, as well as Gates, differ both in their Bigness, and in their Architecture; the biggest are seen in Churches and Halls, *&c.* and are usually arch'd to a Semi-circle.

The moderate ones frequently terminate in an Arch less than a Semi-circle. As to the small ones, they are usually long Squares, their Height being sometimes double their Width, or very nearly so.

Both the one and the other are made more or less simple, or more or less rich, according to the Place, and the Architecture of the Buildings where they are used.

In the *Facade* or Front of a Building, the Windows should be exactly perpendicular under one another; and to that End, Care must be taken, that they be all of the same Width; but in different Stories, their Height must be different; those of the lowest and uppermost Stories may be less high, as well as less adorned, than those of the Middle, which are usually for the Master's Story.

The Width of Windows in respect to that of their Jaumbs, *i. e.* with respect to the Breadth of the Wall between Windows, may be as 3 to 4 in temperate Climates, like that of ours; or as 3 to 5 in Climates that are colder or more hot; or as 3 to 6 in Countries still more exposed to violent Heat or violent Cold; but the various Situations of a Building with regard to *East* and *West*, will always occasion a Variation in the Proportion of Windows themselves.

The Designs of Windows given us by *Vignola*, do very well, as reformed by M. *d' Aviler*, in the Translation he has made of that Author; but it is usual to have Windows much less adorned; and we often make them without any Ornament at all, besides a Plat-band around them, and that too in fine Buildings.

Large Windows should have a Cornish that projects pretty much, to be a Shelter to those who present themselves at them; and in that Case, the Projecture should be supported by two Consoles, as well as the Rest or leaning Place, that terminates the Window at Bottom,

The Consoles of the Cornish should be as big at Bottom as at Top, that they may fall in regularly with the Jaumb and Chambranle.

The Breadth of the Chambranle or Window Frame, may be a sixth Part of that of the Window.

Without the Chambranle is a Plat-band, serving it as an *Arriere-corps*, called a *Montant* or Window-posts, which may have an equal Breadth with the Chambranle, or, on

Occaſion, a little leſs. It ſerves particularly to place the Conſoles of the Corniſh upon.

If the Corniſh be not ſupported upon Conſoles, this Plat-band ſhould be then narrower by one half, and without any Mouldings beſides thoſe that compoſe its Corniſh.

The Conſoles that ſupport the Reſt or Bottom of the Window, ſhould be plac'd underneath the Chambranle, and be equal to it in Breadth, and the Wreathings may be made to run out on the Sides.

The Height of theſe Conſoles muſt not exceed half that of the Opening of the Window at the moſt, nor fall ſhort of a third of that Opening, when the leaſt.

They are uſually made narrower at Bottom than at Top; but in M. *le Clerc*'s Opinion, it would be better to have them equally big.

The Top of the *Perron* or Aſcent, frequently terminates the Bottom of theſe Conſoles.

As for *Windows*, by Statute of 7 of Queen *Anne*, it is ordered as follows.

Whereas it has been the Practice of Workmen to place Window Frames, and Door-caſes very near, and quite ranging with the Outſide Face of the Wall, whereby they are not only fully expoſed to Weather, and thereby decay ſooner, than thoſe that are ſheltered, by being placed at a moderate Diſtance within the Walls, but in time of Fire are more liable to be fired, whereby many Houſes may be deſtroyed; for Prevention of ſuch Practice, it is enacted, that after the firſt Day of *June* 1709, no Door Frame, or Window Frame of Wood, to be fixed in any Houſe or Building within the Cities of *London* and *Weſtminſter*, or their Liberties, ſhall be ſet nearer to the Outſide Face of the Wall than 4 Inches; nor ſhall any Brick-work bear, or be placed upon Timber, or any Sort of Brick-work, excepting upon Plank and Piles where Foundations are bad, on Pain of three Months Impriſonment, without Bail or Mainprize.

But by a Statute made in the 11th of King *George* I. it is made lawful to place Brick-work upon, or over Door Caſes and Windows (provided that the Weight thereof is diſcharged by Arches turned over them) or on Lentils, Breaſt Summers, Story Poſts, or Plates, where required, for the Convenience of a Shop or Shops only.

WITHS. Theſe are uſed by Thatchers, to bind their Thatching Rods to the Rafters.

They are uſually ſold at 6 *d.* the Hundred, and one Hundred of them will do about 3 Square of Thatching; they uſing about 33 or 34 Withs, and as many Thatching Rods (which are of the ſame Price with the Withs) in a Square; for they bind down their Straw at every Foot or thereabouts, *viz.* at every other Lath (for they lath but two Laths in a Foot) and each Courſe of

of Thatching (bound down with one Length of Rods) is about three Foot in Breadth.

WOOD. Great Precautions are to be uſed in buying of Wood; the Situation of the Place muſt firſt be conſidered: Secondly, The Merchant ought to be perfectly acquainted with the Nature and Quality of it; to obſerve how the Trees are furniſhed, and to ſee that they are thick enough for the Places and Uſes they are deſign'd for: He ought alſo to have great Regard to the Bargain he makes, in reſpect to the Time of Payment, that he may make his Money of his Goods, and that he may meet with no Interruption in carrying them off the Ground.

Sometimes the Seller reſerves to himſelf a Number of young Standards for Growth, which are to be mark'd; and therefore the Buyer ſhould make it Part of his Bargain, that in Caſe any of them ſhould happen to be bruis'd or broken by Accident, he is not to ſtand to and be anſwerable for the Damage that way, or otherwiſe done by the Workmen by Malice or Want of Care, for which the Seller muſt call them to an Account.

The Merchant likewiſe ought to covenant for a reaſonable Price to clear the Place of the Wood he buys; and that as Woods do not always ſtand upon or near High-ways, and that many Times there is a Neceſſity they ſhould be carried away over other Peoples Grounds, the Buyer ought to oblige the Seller to procure him free Paſſage for them to the Port, or to which Place he would convey them, without any Moleſtation or Hindrance.

It would be tedious to enumerate the many Articles neceſſary to be agreed in ſuch Bargains or Contracts; that is to be left to every one's Prudence and Experience in that way of Dealing.

As for *Forreſt* or *Timber-trees*, which are thoſe that are ſuffered to grow, according to Notion, from 40 to 200 Years; to underſtand theſe aright as they are ſtanding, is very different, and more difficult than that of Under-wood; in order to which, the Buyer muſt firſt examine the Nature of the Ground where the Forreſts are ſituated; the Sizes of the Trees, and Uſes they are deſigned for.

There are Forreſts which the *French* call *Pleine Futages*, wherein the Trees ſtand ſo thick, that the Sun cannot penetrate into them, and are ſituated in a good Soil: Now the Wood had from thence is always of a very tender Nature, by reaſon of the continual Shade which makes it ſo, and is only proper for Joinery Work.

But if the Ground where the Forreſt grows is ſandy and ſtony, or elſe gravelly; or if the Trees grow in Hedges, and are fully expoſed to the Sun, then you need not heſitate to purchaſe the Timber for Carpentry-work; for the Wood will be hard, and ſo fit for that Uſe.

The uſual Time of cutting down

down Wood, is from *Martinmas* to the End of *February*; and many have ſtrenuouſly contended that it ought to be done in the Wane of the Moon; but it is well known, that the Influences of that Luminary are not efficacious enough to work many of the Effects that are aſcrib'd to it, upon ſublunary Things.

He who buys Wood or Timber-Trees, muſt take Care, if they are not very numerous, to obſerve their Tallneſs and Thickneſs, and not content himſelf with the bare View of them in that reſpect, but make uſe of a Cord to meaſure; and he muſt likewiſe obſerve the Branches, and well weigh what they may yield, and write down a Computation of the whole, that he may take the beſt Meaſures he poſſibly can.

He ſhould have Somebody with him, and beginning at the Foot, meaſure two Fathom upwards, and when that is done, he may judge of the reſt by his Eye proportionably, and ſo adding the whole together, he will very near aſcertain thereby the Height of the Tree.

To know the Thickneſs of a Tree, take a Cord or Line, with which encompaſs the Tree; and that if it be ſix Foot about, fold the Cord into three equal Parts; take off one, and folding the other two remaining ones into 12, in order to take off one Part more; when you have done that, fold the Remainder into four Parts, and you have no more to do than to meaſure the Length thereof, and that will ſhew the Thickneſs of each Part of the Tree.

WREATHED Columns are uſually made very rich, and ſays M. *le Clerc*, ought never to be uſed, but in Places of Diſtinction, as in Altars, Tombs, Salons, and other Places where Magnificence is required.

They ſhould never be uſed to ſupport either Walls or Vaults, or any other conſiderable Burden, by reaſon of their Weakneſs; nor ſhould any thing be laid upon them, beyond a plain, ſlight and delicate Entablature: For tho' they appear by their Circumvolutions to have leſs Delicacy than the common Columns, yet in Effect they have leſs Solidity.

WYDRAUGHT, a Water-Courſe or Water-Paſſage, properly a Sink or Common-Sewer.

X

XYSTOS } XYSTUS } among the ancient *Greeks*, was a Portico of uncommon Length, either open or covered, where the *Athletæ* practiſed Wreſtling and Running. The Word is derived from *Xyon*, *Gr.* to poliſh; it being their Cuſtom to anoint their Bodies with Oil before the Encounter, to prevent their Antagoniſts from taking hold of them.

The *Romans* too had their *Xyſtus*, which was a long Iſle or Portico, ſometimes roofed over, and other times open, and ranged on each Side with Rows of Trees forming an agreeable Proſpect for the People to walk in.

Y

YARD. *A TABLE shewing what Number of odd Feet in a Yard superficial comes to, for any Price by the Yard, from one Farthing* per *Yard, to* 5 l.

The Price of the Yard.	Superficial Feet.	1 s.	1 d.	1 q.pts.	2 s.	2 d.	2 q.pts.	3 s.	3 d.	3 q.pts.
Pounds	1	2	2	2,67	4	5	1,33	6	8	0,00
	2	4	5	1,33	8	10	2,67	13	4	0,00
	3	6	8	0,00	13	4	0,00	20	0	0,00
	4	9	10	2,67	17	9	1,33	26	8	0,00
	5	12	1	1,33	23	2	2,67	33	4	0,00
Shillings	1	0	1	1,33	0	2	2,66	0	4	0,00
	2	0	2	2,66	0	5	1,33	0	8	0,00
	3	0	4	0,00	0	8	0,00	1	0	0,00
	4	0	5	1,33	0	10	2,66	1	4	0,00
	5	0	6	2,66	1	11	1,33	1	8	0,00
	6	0	8	0,00	1	14	0,00	2	0	0,00
	7	0	9	1,33	1	6	2,66	2	4	0,00
	8	0	10	2,66	1	9	1,33	2	8	0,00
	9	1	0	0,00	2	10	0,00	3	0	0,00
	10	1	1	1,33	2	12	2,66	3	4	0,00
Pence	1	0	0	0,44	0	0	0,89	0	0	1,33
	2	0	0	0,89	0	0	1,78	0	0	2,66
	3	0	0	1,33	0	0	2,67	0	1	0,00
	4	0	0	1,77	0	0	3,54	0	1	1,33
	5	0	0	2,22	0	1	1,43	0	1	2,66
	6	0	0	2,66	0	1	2,32	0	2	0,00
	7	0	0	3,10	0	1	3,21	0	2	1,33
	8	0	0	3,55	0	2	0,10	0	2	2,66
	9	0	1	0,00	0	2	0,99	0	3	0,00
	10	0	1	0,44	0	2	1,88	0	3	1,33
	11	0	1	0,89	0	2	2,77	0	3	2,66
Farth.	1	0	0	0,11	0	0	0,22	0	0	0,33
	2	0	0	0,22	0	0	0,44	0	0	0,67
	3	0	0	0,33	0	0	0,66	0	0	1,00

Super-

Superf. Feet.			4			5			6		
			s.	d.	q.pts.	s.	d.	q.pts.	s.	d.	q.pts.
The Price of the Yard.	Pounds.	1	8	10	2,67	11	1	1,33	13	4	0,00
		2	17	9	1,33	22	2	2,67	26	8	0,00
		3	26	8	0,00	33	4	0,00	40	0	0,00
		4	35	6	2,67	44	5	1,33	53	4	0,00
		5	44	5	1,33	55	6	2,67	66	8	0,60
	Shillings.	1	0	5	1,33	0	6	2,66	0	8	0,00
		2	0	10	2,66	1	1	1,33	1	4	0,00
		3	1	4	0,00	1	8	0,00	2	0	0,00
		4	1	9	1,33	2	2	2,66	2	8	0,00
		5	2	2	2,66	2	9	1,33	3	4	0,00
		6	2	8	0,00	3	4	0,00	4	0	0,00
		7	3	1	1,33	3	10	2,66	4	8	0,00
		8	3	6	2,66	3	5	1,33	5	4	0,00
		9	4	0	0,00	5	0	0,00	6	0	0,00
		10	4	5	1,33	5	6	2,66	6	8	0,00
	Pence.	1	0	0	0,44	0	0	2,22	0	0	2,66
		2	0	0	3,54	0	0	0,44	0	1	1,32
		3	0	1	1,32	0	1	2,68	0	2	0,00
		4	0	1	3,10	0	2	0,88	0	2	2,66
		5	0	2	0,87	0	2	3,10	0	3	1,33
		6	0	2	2,64	0	3	1,32	0	4	0,00
		7	0	2	0,42	0	3	3,54	0	4	2,66
		8	0	3	2,20	0	4	1,76	0	5	1,33
		9	0	3	0,93	0	4	3,98	0	6	0,00
		10	0	4	1,76	0	5	2,20	0	6	2,66
		11	0	4	3,53	0	6	0,42	0	7	1,33
	Farth.	1	0	0	0,44	0	0	0,55	0	0	0,67
		2	0	0	0,88	0	0	1,10	0	0	1,33
		3	0	0	0,33	0	0	1,65	0	0	2,00

			7	8	9
Superf. Feet.			s. d. q.pts.	s. d. q.pts.	s. d. q.pts.
The Price of the Yard.	Pounds.	1	15 6 2,67	17 9 1,33	20 0 0,00
		2	31 1 1,33	35 6 2,67	40 0 0,00
		3	46 8 0,00	53 4 0,00	60 0 0,00
		4	62 2 2,67	71 1 1,33	80 0 0,00
		5	77 9 1,33	88 10 2,66	100 0 0,00
	Shillings.	1	0 6 1,33	0 10 2,66	1 0 0,00
		2	1 9 2,67	1 9 1,33	2 0 0,00
		3	2 4 0,00	2 8 0,00	3 0 0,00
		4	3 1 1,33	3 6 2,67	4 0 0,00
		5	3 10 2,67	4 5 1,33	5 0 0,00
		6	4 8 0,00	5 4 0,00	6 0 0,00
		7	5 5 1,33	6 2 2,67	7 0 0,00
		8	6 2 2,67	7 1 1,33	8 0 0,00
		9	7 0 0,00	8 0 0,00	9 0 0,00
		10	7 9 1,33	8 10 2,66	10 0 0,00
	Pence.	1	0 0 3,10	0 0 3,55	0 1 0,00
		2	0 1 2,20	0 1 3,10	0 2 0,00
		3	0 3 4,40	0 2 2,65	0 3 0,00
		4	0 3 3,50	0 3 2,20	0 4 0,00
		5	0 4 2,60	0 4 1,75	0 5 0,00
		6	0 5 1,70	0 5 1,30	0 6 0,00
		7	0 6 0,80	0 6 0,85	0 7 0,00
		8	0 6 3,90	0 7 0,40	0 8 0,00
		9	0 7 3,10	0 8 0,95	0 9 0,00
		10	0 8 2,10	0 9 0,50	0 10 0,00
		11		0 10 0,05	0 11 0,00
	Farth.	1	0 0 0,77	0 0 0,88	0 0 1,00
		2	0 0 1,54	0 0 1,76	0 0 2,00
		3	0 0 2,31	0 0 2,66	0 0 3,00

Ex-

Explanation of this Table.

First, at the Head of the Table are the odd Feet contained in a Yard superficial, beginning at one Foot, and ending at a Yard.

At the Bottom of the Table you have the Number of Feet in a cubical Yard, numbred by 3, 6, 9, *&c.* to a Yard solid.

In the first Column on the left Hand, is placed the Price of a Yard, from one Farthing to 5 *l. per* Yard, and in the other Columns under the odd Feet, is the Price in Shillings, Pence, Farthings, and hundred Parts of a Farthing, that any Number of odd Feet come to.

The Use of the Table.

EXAMPLE 1.

At 8 d. per *Yard, what comes 6 Feet to?*

Look for 8 *d.* in the first Column, and under 6 Feet in the Angle of Meeting, you will find 00 *s.* 5 *d.* 1 *q.* 33; that is, 00 *s.* 5 *d.* $\frac{1}{4}$ 1 Farthing and 33 hundred Parts of a Farthing, which is the Price or Value of 6 Feet, at 8 *d.* the Yard superficial Measure.

EXAMPLE. 2.

At 5 s. 4. d. $\frac{1}{2}$ *a Yard, what comes* 8 *Feet to?*

	s.	d.	q.pts.
8 Foot at 5 *s.* is	4 :	5 :	1,33
8 Foot at 4 *d.* is	0 :	3 :	2,20
8 Foot at $\frac{1}{2}$ is	0 :	0 :	1,76
	4 :	9 :	1,29

Z

ZOCCO, ZOCCOLO, ZOCLE, SOCLE [*in Architecture*] is a small Kind of Standing or Pedestal; being a low Square Piece or Member serving to support a Busto, Statue, or the like, that there is Occasion to be rais'd.

The Word is *Italian*, form'd from *Soccus*, a Sandal, or high Shoe.

ZOCCO, ZOCLE also signifies a low Square Member serving to support a Column or other Part of a Building, instead of a Pedestal Base, or Plinth.

A continued ZOCLE is a kind of continued Pedestal whereon a Structure is raised; but having no Base or Cornish.

ZOOPHORUS, ZOOPHOROS [*in the ancient Architecture*] is the same Thing with the *Frieze* in the modern.

It was thus called in the *Greek*, because anciently adorned with the Figures of Animals from Ζῶον, an Animal, and φέρω, a Bear.

ZOOPHORICK Column, is a Statuary Column; or a Column that bears and supports the Figure of an Animal.

FINIS.

SUPPLEMENT.

The following are Additions and Corrections communicated to the Compiler of this Work after the Sheets were printed off, therefore not being willing to omit any Thing that may be of Service to the Publick, but to make this Work as compleat as possible, we have inserted them here by Way of Supplement.

IN the Article INTERTIES, for *smaller*, read *larger*.

To the Article JOISTS, for [illegible] read 12; for 8 Inches read 6; and for the Word *Furr* read *Bridge*.

In the Article KEYS, as to the Price, read from 2 or 3 *s.* to 20 *s.*

To the Article LATHS, add *Kentish Laths*, which are accounted as good as any are, about 1¼ Inch broad, and a full ¼ of an Inch thick, one with the other, and are sold in most Places of *Kent* for 2 *s.* 6 *d. per* Bundle.

To the Price of laying on Sheet LEAD in Roofing add, it is now worth 18 or 19 *s. per* Hundred Weight.

To the Article LIME after *Load of Lime*, add: here must be meant Ruble-Work, for square Stone-Work takes up much less Lime than Brick-work, and the Allowance is the same as is there mentioned.

To the Article LINTEL as to the Price, add: Carpenters put in these by the Cubed Foot, 20 *d.* for Firr and 3 *s.* for Oak.

To the Article MORTAR, after the Paragraph *How much allow'd*, &c. add: But if the Work be done well, it will take up near two hundred of Lime.

In the Article OGEE, leave out, or of a round or a hollow, like an S.

In the Article PAINTING, at Paragraph; *Out Door Work* instead of 3 *d.* &c. read, from 5 *d.* to 7 *d.* the Yard square.

In Paragraph, *Gates and outward Doors*, instead of 3 *d.* &c. read from 5 *d.* to 6 *d. per* Yard.

In *Sash Lights*, for 1 *s.* read 1 *d*

In *Sash Frames* read from 1 *s.* *per* Frame to 2 *s.*

In the Article PALEING, add; that they cleave only that Part of the Timber which is without Knots; but when they saw, they saw Knots and all; and for this Reason they can make it a great deal more by sawing than cleaving.

To PAVING with *Rough* or *Rag-Stone*, add: or 4 *d. per* Yard Workmanship.

PEERS; instead of this Article, read,

PEER [in *Architecture*] a solid Wall between two Doors or Windows; also a short square Pillar, with Base and Capital, plac'd before a Gentleman's House for Ornament, and differs from a Pilaster in this, that they are shorter, and the Base and Capital are the same that Architects give to Pedestals.

In the Article PILES, after mortois'd, add tenon'd.

PLANE. Instead of the Articles *Plane* in the Dictionary, take these that follow.

PLANES have various Names, according to their various Forms and Uses.

The *Fore Plain* (or as the *Dutch* call it the *Fore Loper*) is about 18 Inches long; is the first used to take off the greater Irregularities of the Stuff, to prepare it for the *Trying Plane*, or the *Long Plane*; the Edge of its Iron is ground with a Convex Arch, to bear being set the ranker.

The *Trying* or *Long Plane*, is about two Foot long; its Use is to make the Work strait, and prepare it for the Jointer.

Jointer is the longest of all, about $2\frac{1}{2}$ Foot long, the Edge of its Iron being very fine, its Use being to join two Boards together, and make both Edges perfectly strait and fit to glew.

It has been often said by some good Workmen, that there is nothing to be made perfectly strait, round or square; yet I believe a very curious Workman may do either of them, and demonstrate them to be so, as for Instance to make a Board strait.

Take two thin Boards, about three or four Foot long, more or less, and shoot them both together with a good Jointer till they will join and be close every way, which may easily be done by a good Hand. Then will both Edges of these Boards be perfect strait Lines, for otherwise they would not join and be close.

The *Smoothing Plane* is a short Plane about six or seven Inches long: its chief Use is to smooth and finish the Work.

The *Strike Block* is a short Jointer, about 13 or 14 Inches long, to join Mouldings and short Work.

The *Rabbet Plane*: The Iron of this Plane is full as broad as the Stock, that the Angle may cut strait, and it delivers its Shaving at the Sides, and not at the Top like other Planes; its Use is to make Slopes of Right Angles in the Edge of a Board, and Fillets in Mouldings, as the Anulets in the *Doric* Capital, &c.

The *Plow*. Its Use is to plow narrow square Groves in the

the Edge of a Board to receive the Edge of a thinner Board as the Edges of the Frameing is plowed to receive the Edges of the Panneling in a Room of Wainscot.

Moulding Planes are of various Kinds, accomodated to the various Forms and Profiles of the Mouldings.

Round and Hollow Planes, are of several Sizes, from half a Quarter of an Inch, to two Inches and upwards; and curious Workmen have 16 Pair of these Planes, each differing half a Quarter of an Inch, with which, and the Snipes Bill and Rabbet Plane, they Work the various Sorts of Mouldings.

In the Article POINT, to the End, add, or Beginning of Magnitude.

Instead of the Article PUNCHINS, read, they are those that are placed next a Door or Window, and are called Door or Window Punchins.

In the Article inclin'd PLANES, for *Obique* read *Oblique*.

In the Article the PULLEY, in the Article 3. *If a Power applied in B*, &c. in the 3d Line of the second Column, for G E read G F; in Line 8, for F L read E L and in Line 9, for B read F.

In Article RAILS, add; But the Price of these is various, according to the Workmanship.

RAISING Pieces [in *Carpentry*] are those Pieces that lie on the Tops of the Post and Punchions, and under the Beams; those that lie on Brick-work, and under the Beams, are called Platbands.

In the Article RHOMBOIDES, in Column 2, Line 9, for A B C, *read* A B C D; and Line 18, for B C *read* D C; and Line 21, for C B E, *read* C B F.

In the Article ROOFS, in the Sheet whose Signature at the Bottom is P, in the second Page, and second Column, and second Line, for *Carvings*, read *Furrings*; and after Line 20, the six Particulars beginning 1 Chamber Beam, and ending 6 Battlements, do all belong to the Article, entituled Flat-Roofs, *Plate* 3, and are immediately to follow the End of that Article, the last Line of which is; *Drips may be made to walk on.*

To the Article SAND, add, Pit-Sand is much inferior to River-Sand, because not purged; Sea-Sand is the worse because salt; but that Sand taken from *Barkin-shelf*, which is between fresh and salt, will make good Mortar, as I have proved my self.

In the Article SELLS, add, the Rates or Prices beforementioned are to be understood only of small Buildings: for putting in Sells to large Houses in *London* is very dear Work, the Price of which cannot be ascertained.

In the last Paragraph, just before STAIR-CASE, immediately after the Words; *by the Number of Stairs*, add the following Words; *less by one; for the last Rise-up is not to be accounted in the Breadth.*

At the latter End of the Article Stair-cases, add, tho' these Sort of Elm-Stairs were much in use after the Fire of *London*, and might be the Price at that Time; yet the Price of Stairs cannot be ascertained, there is so much Difference in the Goodness of the Workmanship.

To the Article SUMMER, add, *Summer* in *Carpentry* is a large Piece of Timber to which the Girders are fram'd.

Price of plain Tileing in *London* (is 25 or 26 *s. per* Square, Ripping Old Tileing is worth from 14 to 18 *s. per* Square, according to the Goodness of the old Tiles.

Pan-tileing pointed is worth 1 *l.* 0 *s.* 6 *d.* plain *Ditto* 18 *s.* ript 10 *s.* *Dutch* glaz'd 1 *l.* 15 *s.* *English Ditto* 1 *l.* 10 *s.*

Those who have no mind to make use of the Tables for Tileing, &c. may find the Price or Value by this easy Method.

Admit a Piece of Tileing to be 46--8 Inches long, and 32 Foot broad, at 26 *s. per* Square; *What is the Amount?*

```
  46-8
  32
 ------
 14.93-4   Which is 14 Square, 93 Foot and 4 Inches,
  26          which multiply by 26 s. the Price.
 ------
  8958
 2986
    8-8
 ------
388.26:8   Which is 388 Shillings and 26/100, the 8 Parts
 ------         not worth regarding in this Case = to
                19 l. 8 s. 3 d.
```

Reduce the 26/100 by the Rule aforegoing.

```
 26
 12
 ---
 52   Which is 3 d. and near 1/2 of a Penny not worth
 26        regarding.
 ---
 3.12
    4
 ---
  48
```

Another

Another Example to find the Value of a Piece of Tileing.

Suppose a Piece of Tileing to be 35 Foot 7 Inches long, and 22 Foot deep.

```
     35-7
     22
   ------
     70
     70
      12-10
   ------
   7.82-10   Which is 7 Square 82 Foot 10
     27- 6   Inches, at 27 s. 6 d.
   ------
    5474
   1564
      22-6
    391-0
         5   Which is 10 l. 15 s. 3 1/4 140/144
   ------
Shillings 215.27-11
       12
   ------
      54
      27
      11
   ------
Pence  3.35
        4
   ------
Farthings 1.40
```

See

See how it will anſwer with the firſt Example.

	Feet.
A Square is	100
Three Quarters	75
Half	50
A Quarter	25
18 Feet	18
	268

268 Which is two Square, 68 Foot at 14 *s. per* Square

```
 2.68
   14
------
 1072
 268
------
37.52
   11
------
 104
 52
------
 6.24
    4
------
  .96
```

Which is 37 Shillings, and $\frac{52}{100}$, which reduced, is = to 1 *l.* 17 *s.* 6 *d.* $\frac{96}{100}$, almoſt a Farthing.

This Method is more exact than the Tables, very eaſy, and with much leſs Trouble, and I believe will be acceptable to thoſe whoſe Hands it may fall into.

To the Article TIMBER, add, How much Timber will compleat a Square of Building? *Anſwer*, Twenty Foot of ſolid Timber will compleat a Square or 100 Feet of ordinary Houſe Building, one Part with the other.

But large and maſſive Frameing may take up double or treble that Quantity, and ſlight Framing may be done with leſs.

In the Article TIMBER, and in the Paragraph *Felling*, add, Felling Timber, and cutting the

the Top Wood, is from Two Shillings and Six Pence to Three Shillings and Six Pence, and hewing about Two Shillings.

In the Example 1. of Timber, for Sum 1 *l.* 03 *s.* 05 *d.* *read* 1 *l.* 17 *s.* 05 *d.*

In the Sheet whose Signature at Bottom is D d, and Article, *If a Wall be* 104 *Feet* 9 *Inches*, &c. mind not the working in that Page but this which follows.

```
           104—9
            17—3
          ———————
          728
         104
            12—9
            26—2—3
      ——————————————
272 )18c6—11—3( 6
     1632
  68) 174 ( 2
      136
      ———
       38
```

Answer, Six Rods ½ 38 Foot, 11 Inches, 3 Parts.

N. B. We hope the Reader will make all proper Allowances in the Prices; as better Workmanship or Materials may exceed the Schemes of our Computations.

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